March, 1946 PRICE $1.00

INDUSTRIAL ARTS AND VOCATIONAL EDUCATION

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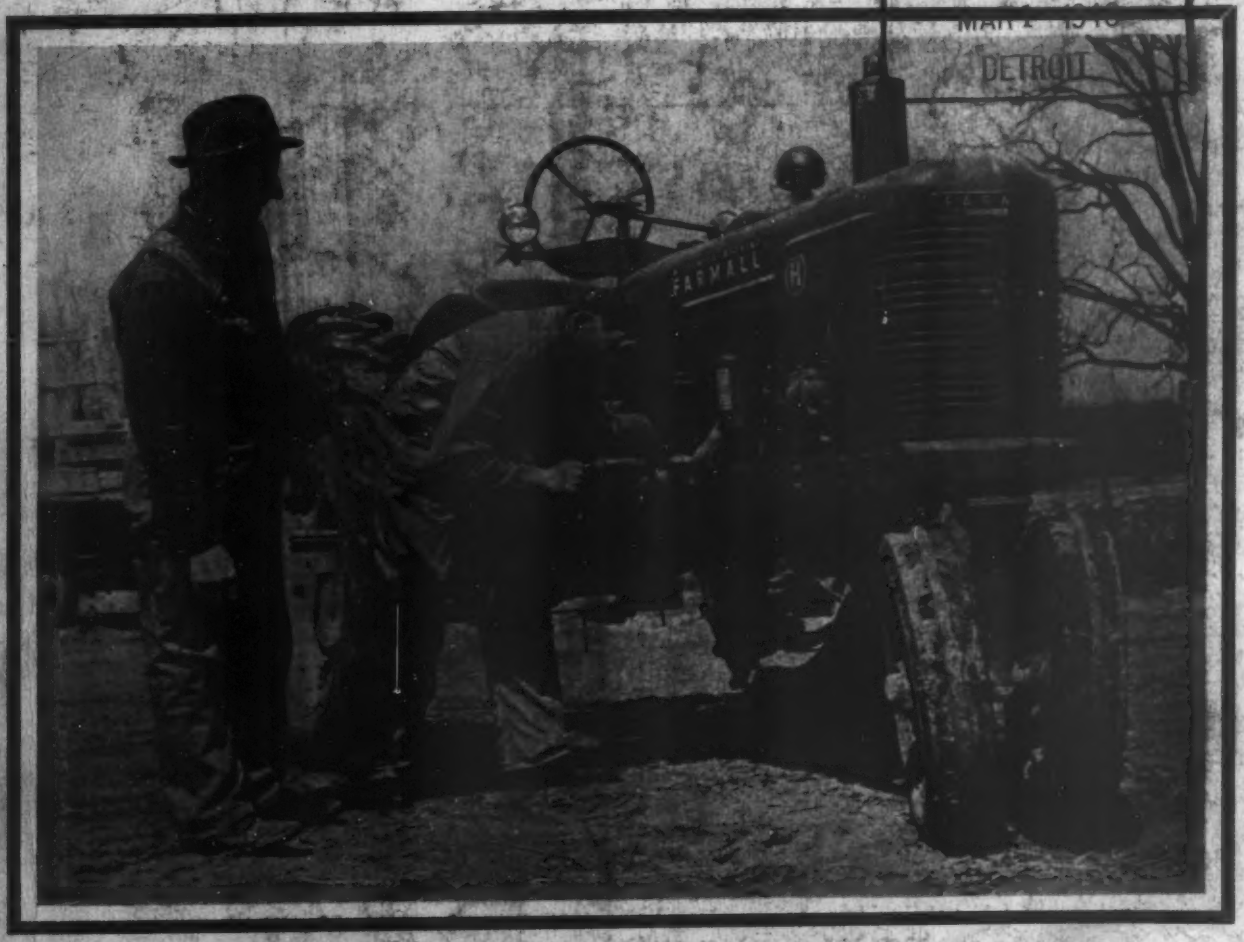
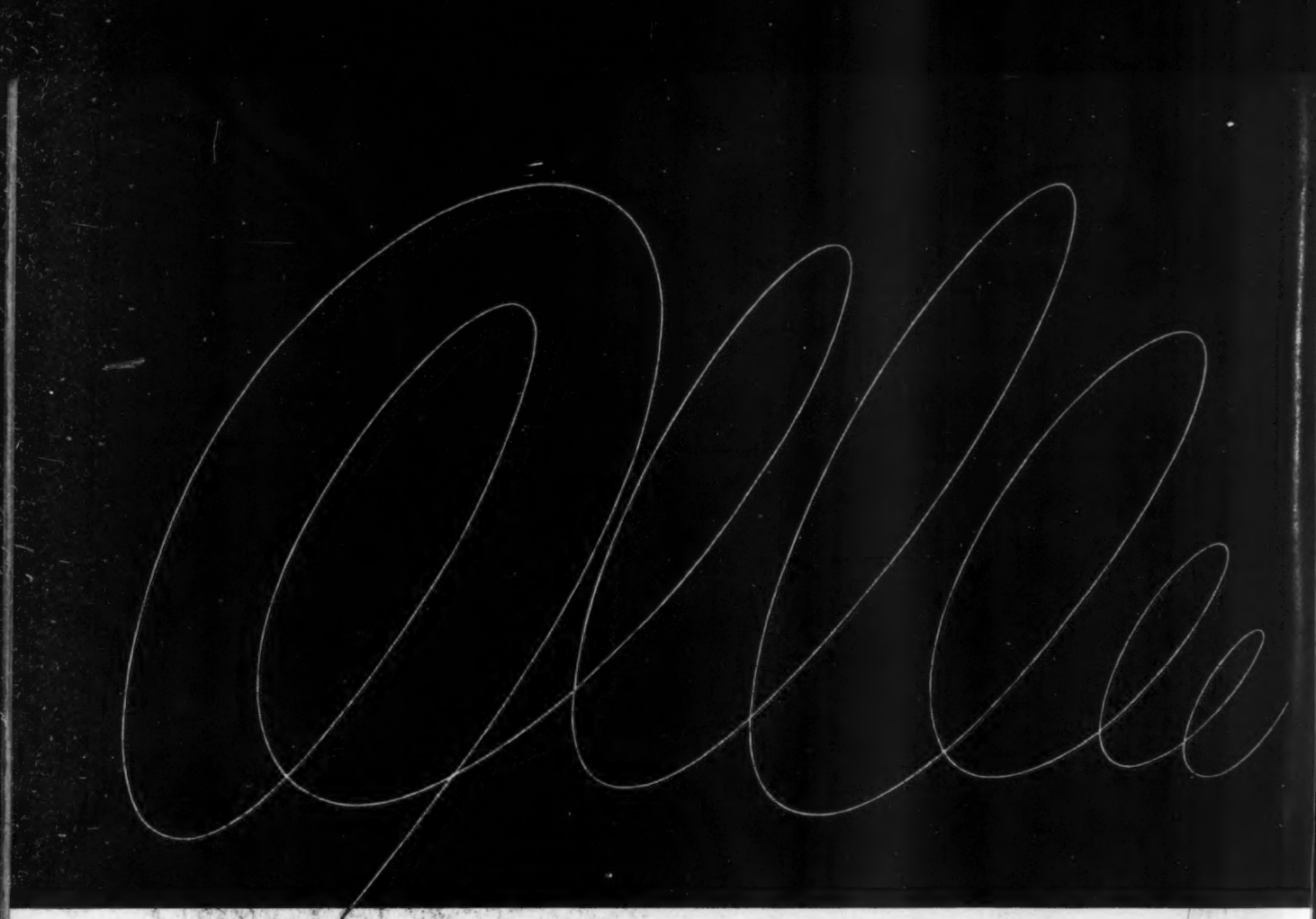


SCHOOL SHOP ANNUAL

The Shop Teachers' Professional Magazine



It's a test of a man's Vision

This is a piece of wire, ordinary steel wire. Most men, encountering such a bit of metal in their path, would not give it a second glance, let alone a second thought. Yet . . . in the hands of men of vision . . . it becomes a vital component in a miracle—the miracle of magnetic wire-recording which in the years to come may well affect the lives of millions of people.

So it is with the ordinary metal of human nature, by some men thought not worth a second look. Yet it must be obvious that from this common clay are fashioned tomorrow's citizens for good or for ill. Educators with insight and penetration know that here alone is the source from which achievement in any field is to be drawn. Every boy in school possesses more energy than he can ever use . . . far more talent than will ordinarily see the light of day . . . hungers and urges toward the boy knows not what and cannot know unless someone points the way.

How shall this pointing be done? How shall energy be mobilized toward a worthwhile goal? How shall ambition be strengthened? How can a feeling for craftsmanship be aroused and sound standards established? How indeed if the educator fails in his primary responsibility?

The very drawing instruments a boy uses in mechanical drafting are a case in point. These are the instruments used by engineers whose exploits can fire the imagination and stir the desire to emulate in every mechanically minded lad . . . especially if the boy, at the threshold of manhood, has the inspiration of tools worthy of grown men. The selection of his drawing instruments is an initial step on the road that leads to adult achievement. Here, too, "Well begun is half done." All men respond to fine workmanship. Shall the quality of the student's equipment be less than enough to win his respect? The human mind moves by analogy, from small to great, from near to far. In what direction shall these near, "small" steps lead? *Any educator who weighs these questions knows that to let a boy work with any but the finest equipment he can afford is to contradict all that the educator has learned about the fundamental educational process.*

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In most school shops a careful survey will show that much of the equipment has been worn or damaged beyond repair during the strenuous war production training period when over-crowded classes kept machines going twenty-four hours a day.

Plans for a complete modernization and replacement program should be made at once so that orders for machinery can be placed now. Although shop equipment has been hard to get during the past few years (most of it going to the armed forces and war production plants) conditions are rapidly improving and orders from educational institutions can now be accepted.

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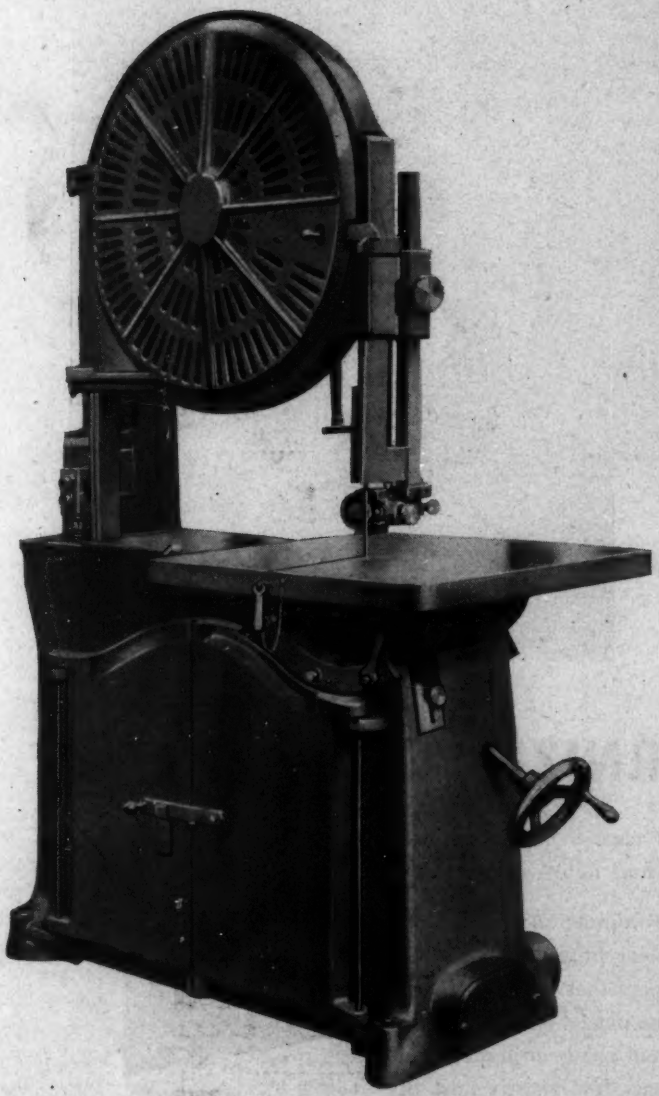

Y-36 Band Saw — Has everything that is needed and desired in a machine of this type. The frame is exceptionally heavy, yet it is so compact that it occupies less floor space than some lighter saws. The combination straight and gooseneck type of column has a distinct advantage over ordinary styles. A sensitive knife-edge straining device maintains proper blade tension at all times. Adjustable internal expanding brakes provide instantaneous stopping. Wheels and saw blades are completely guarded.

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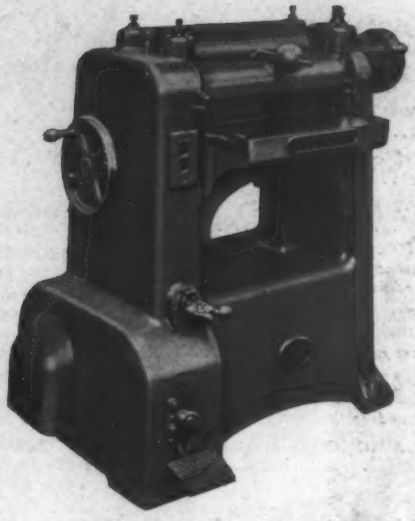
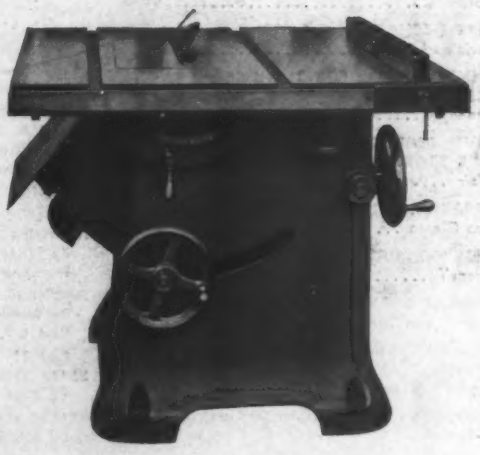


G-89 Tilting Arbor Variety Saw — Like all Yates-American saws the G-89 is designed for extreme accuracy on all straight or bevel cuts. It is built on a sturdy, one-piece frame with clean-cut sides, devoid of projecting parts. The rotor of the 3600 R.P.M. motor is mounted directly on the tilting arbor—there are no gears or belts to cause loss of power. Motor is totally enclosed, fan-cooled and dust-proof. The arbor and motor unit is mounted on accurately machined segment gibs for easy, precision tilting.



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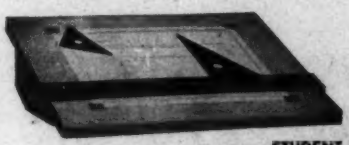

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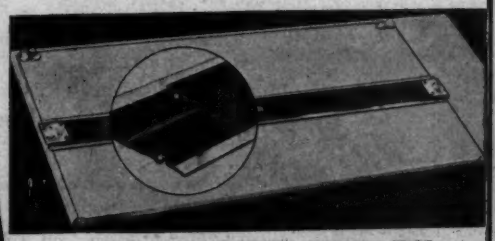

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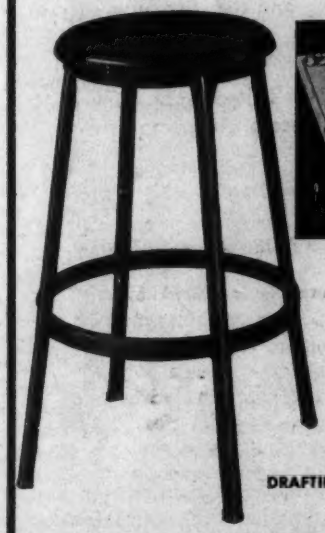

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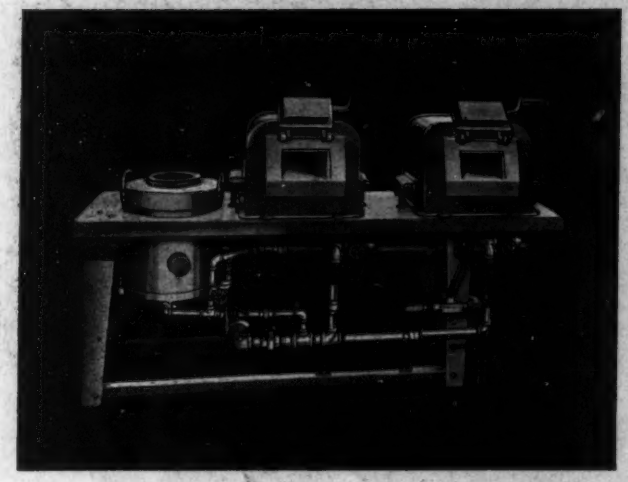

STEWART TRIPLE-PURPOSE FURNACES

Because of its wide range of usefulness the Stewart Triple-purpose Furnace (E), shown at the left, designed for operation on gas at ¼ lb. pressure and air at 1 lb. pressure, is a basic metalworking unit for school or small shop work. It combines three of Stewart's most popular small furnaces: (1) No. 28 Oven (temperature range 1400° to 1800°), (2) No. 28C Oven (temperature range 1800° to 2400°), (3) B612 Pot Furnace (temperature range 400° to 1600°). To supply the air required, the Turbo-blower shown mounted on the unit has been found most satisfactory. Because of the precise requirements of today's heat treating, temperature-indicating equipment is recommended. A single pyrometer instrument can be used with a thermocouple selector switch, and a thermocouple with lead wire for each of the three furnace sections.

HEAT TREATING OPERATIONS OF THE STEWART TRIPLE-PURPOSE FURNACE

Oven Furnace Hardening Carbon Steels . . . in No. 28 Oven Section.
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Melting Brass Bronze, etc. . . . in B612 Pot Section (with crucible).

STEWART SMALL SEMI-MUFFLE FURNACES AND ROUND POT TEMPERING FURNACES

(For heat treating larger parts, Stewart small Semi-muffle Furnaces are available with work chambers as large as 6" high x 12" wide x 22" long. These furnaces are the same general design and specification as sections 28 and 28C of the Triple-purpose Furnace shown above.)

SMALL SEMI-MUFFLE FURNACE

Handy, compact general purpose furnaces widely used in small shops, tool rooms, and schools for a wide variety of work such as annealing, carburizing, hardening, and general heat treating. They are quickly brought up to heat, making them particularly desirable for intermittent use. With their standard heavy duty molded linings they are easy to maintain and operate. The large number of burners on gas-fired units firing underneath semi-muffle hearth provide maximum temperature uniformity and production. Available in several standard hearth sizes as large as 12" x 22".

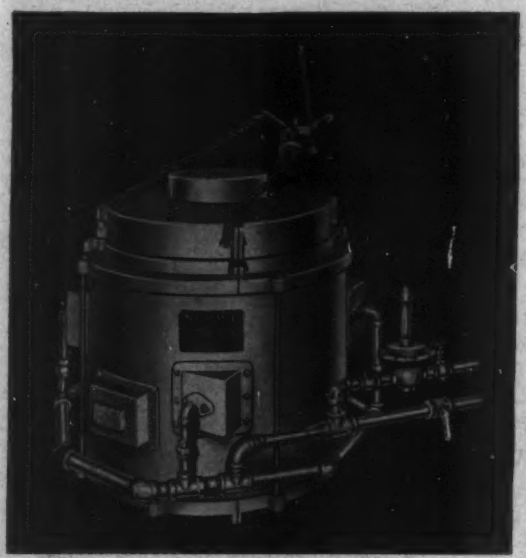
ROUND TEMPERING FURNACE

Following the hardening of the work in the Stewart small Semi-muffle Furnace shown above, the work should be tempered, drawn, or stress relieved in a Stewart Round Tempering Furnace, using oil, lead or salt in the heating bath. These furnaces are available with pots from 12" in diameter to 18" in diameter, and from 12" deep to 20" deep in standard sizes. Standard temperature ranges are 400° to 800°, or 800° to 1200°. Combinations of these ranges are also available.

FOR SCHOOL SHOP METALWORKING REQUIREMENTS

STEWART SMALL FORGE FURNACES

Where training in modern forge practice is given, these small Stewart Forge Furnaces are standard equipment in many technical schools and colleges. They are ideal for general forging, forming, and tool dressing work. Sturdily constructed, and highly efficient in operation, with uniform, quick heats. The linings are simple and easily maintained, yet efficient and enduring. Designed for operation on gas at ¼ lb. pressure only, and also require air at 1 lb. pressure. Since the temperatures at which the operations are done are usually not critical, pyrometer equipment is not required.



STEWART NON-FERROUS METAL MELTING FURNACE

These furnaces are designed for the melting of brass, aluminum, tin, nickel alloys, copper, copper alloys, gold alloys, magnesium, zinc, lead, cadmium, nickel-silver, bronze, beryllium, antimony, etc. Widely used in school and shops for many small casting jobs. The swinging top made of one piece of molded refractory, banded to add strength, lifts easily from the body of the furnace by means of a special mechanism, and swings to one side, giving a clear opening into the body of the furnace—a feature much appreciated at casting time. The linings are of high grade refractory material, sufficiently heavy to resist the abrasive action of the swirling flame which the burners set up. They are available in several sizes, with crucible capacities from 12, 36 and 105 lbs. of brass up. The smallest size is designed for gas only; other sizes can also be supplied for oil fuel. All sizes require air at 1 lb. pressure. Ordinarily no pyrometer or temperature-measuring equipment is required.

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For many general gas brazing jobs, low temperature welding work, and other school and shop needs, this Stewart Brazing Table has proven very satisfactory in hundreds of installations. The blow pipes are pivoted and hinged so blast may be directed at any angle from either nozzle and concentrated at any spot. Blow pipes can be equipped with special nozzles for specific operations as required.

Get Your FREE Copy of Guide to Furnace Selection

For instruction purposes, copies of the Stewart Guide to Furnace Selection is available without charge to educators. This guide can be used to find quickly the type of gas or oil-fired furnace best suited to any work. This guide is also intended to assist in finding the heating time required, the heating medium to be used, and from these, the type of furnace best suited for a particular heat treating operation with regard for the production required and the weight and size of the material to be heated.

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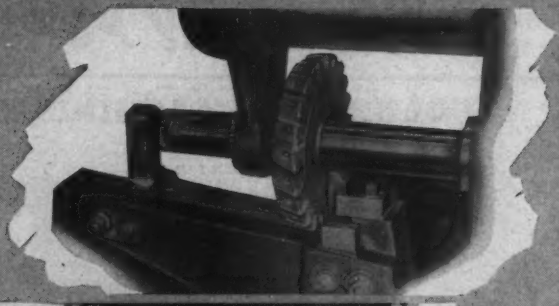

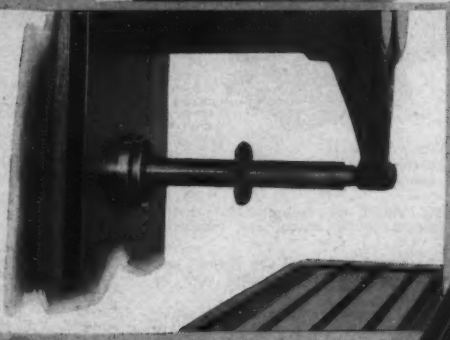

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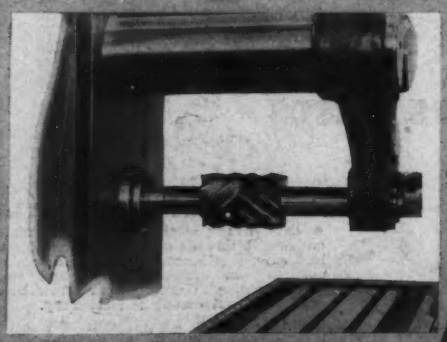

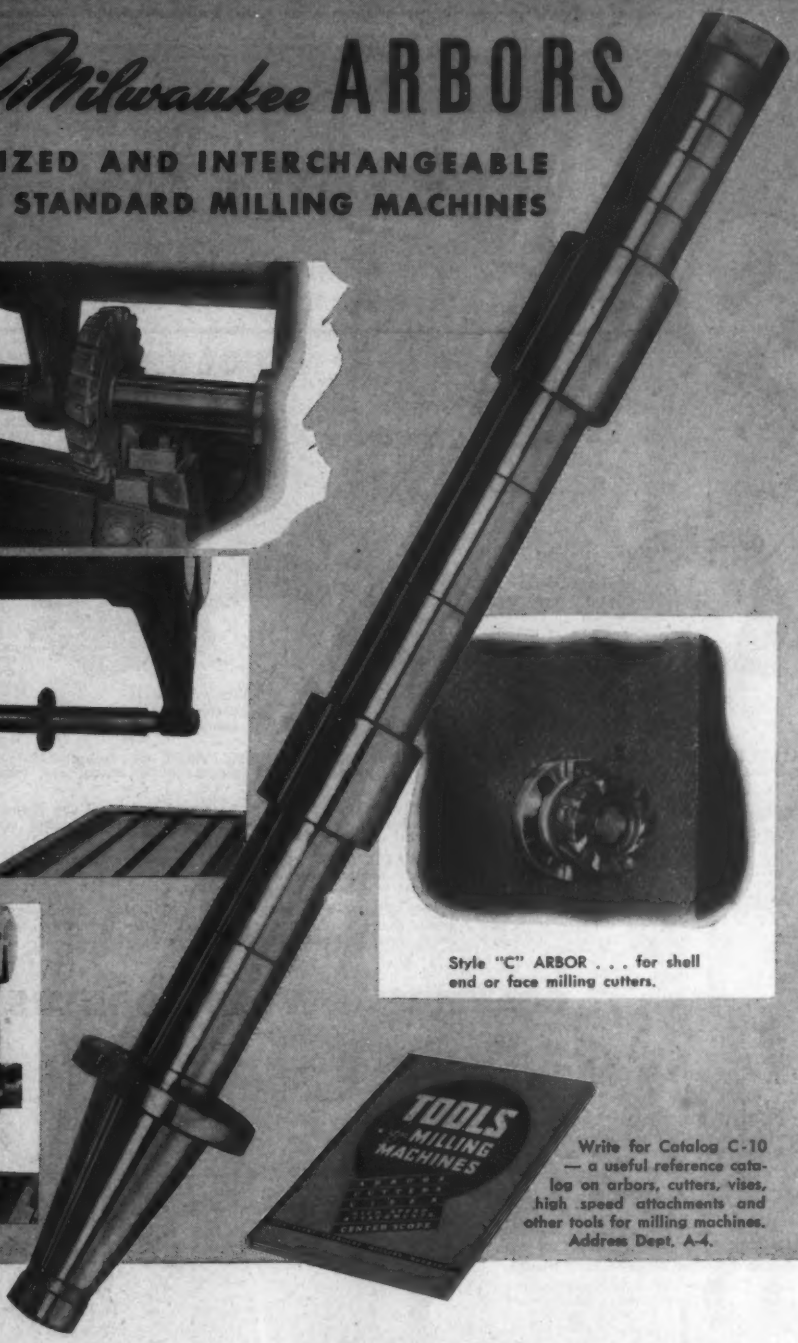

Style "C" ARBOR . . . for shell end or face milling cutters.

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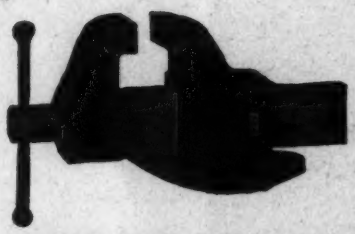


REPLACEABLE TOOL STEEL JAW FACES
STEEL BALL ENDS FORGED FROM HANDLE STOCK ITSELF
COLD ROLLED STEEL SCREW
SELF-LUBRICATING THRUST BEARING
POSITIVE LOCKING SWIVEL BENCH PLATE
SLEDGE TESTED
MALLEABLE IRON CASTINGS GUARANTEED UNBREAKABLE

• STATIONARY BASE VISES are machined flat and can be mounted without cutting the bench.

Stationary Base Machinists' Vises

Vise No.	Width Jaws	Jaws Open	Weight Pounds
503	3	4½	20
503½	3½	5½	29
504	4	6	36
504½	4½	7	47
505	5	8	58
506	6	10	90

• COLUMBIAN MACHINISTS' VISES are designed to provide accurate and dependable equipment for school and industrial shops.

T SECTION JAW FACES of hardened tool steel are pinned into the castings so they cannot come loose in use, but may be replaced if chipped or worn.

MALLEABLE IRON CASTINGS, an exclusive Columbian Machinists' Vise feature, provide increased working strength and are absolutely guaranteed unbreakable.

STEEL SCREW and MALLEABLE IRON NUT are designed for heavy duty. Hardened steel washer under the screw head prevents wear on front jaw casting.

• SWIVEL BASE VISES are positively locked by a forged steel lock bolt, designed with teeth which are drawn into gear-like corrugations in the base plate.

Swivel Base Machinists' Vises

Vise No.	Width Jaws	Jaws Open	Weight Pounds
603	3	4½	25
603½	3½	5½	34
604	4	6	42
604½	4½	7	55
605	5	8	70
606	6	10	106

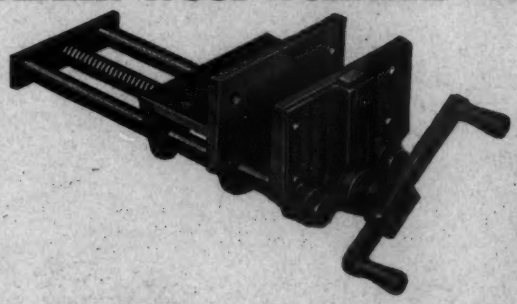
COLUMBIAN WOODWORKERS' VISES

Rapid Acting Woodworkers' Vises

• Simple rapid acting mechanism consists of a bronze half-nut operating in the groove produced by milling off a section of each thread for the length of the screw. A slight turn of the handle engages the threads of the nut and screw, and a half turn tightens the vise to the work.

MADE IN ALL POPULAR SIZES

Rapid Acting Woodworkers' Vises	Plain Front Jaw		Dog in Front Jaw	
Vise No.	1R	9R	1RD	9RD
Jaw Size, In.	4x7	4x10	4x7	4x10
Jaws Open, In.	9	12	9	12
Weight, lbs.	24	32	25	33



• ADJUSTABLE STEEL HANDLE increases speed of operation. With the handle centered at the screw head, the shortened radius permits quick adjustment of opening. By extending the handle, extra leverage is obtained to tighten the vise.

Continuous Screw Steel Handle Vises	Plain Front Jaw		Dog in Front Jaw	
Vise No.	5C-S	3C-S	5CD-S	3CD-S
Jaw Size, In.	4x7	4x10	4x7	4x10
Jaws Open, In.	9	12	9	12
Weight, lbs.	24	32	25	33

Continuous Screw Woodworkers' Vises

• Extra heavy steel screw with carefully cut double threads operates in a solid malleable iron self-centering nut and insures positive fast action. Cold rolled steel guide rods, with drag bar as screw bearing, insure alignment and accuracy.

Continuous Screw Wood Handle Vises	Plain Front Jaw		Dog in Front Jaw	
Vise No.	5C	3C	5CD	3CD
Jaw Size, In.	4x7	4x10	4x7	4x10
Jaws Open, In.	9	12	9	12
Weight, lbs.	22	30	23	31

The Columbian Line also includes Combination Pipe Vises, Hinged Pipe Vises, Homeshop Vises, Blacksmiths' Leg Vises, Bench Anvils, and "C" Clamps.

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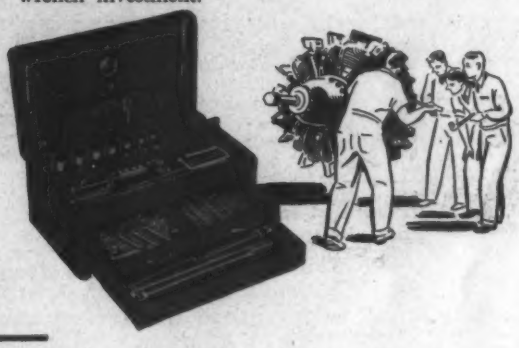

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Porto-Power is basic in repairing, rebuilding and reconditioning autos, trucks, tractors, implements and airplanes. This same hydraulic equipment is used throughout industry and construction. A MUST in modern training!

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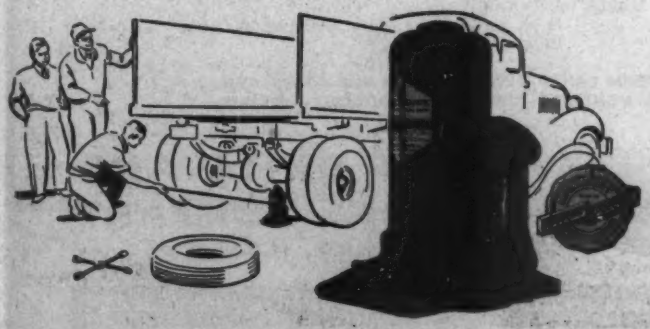

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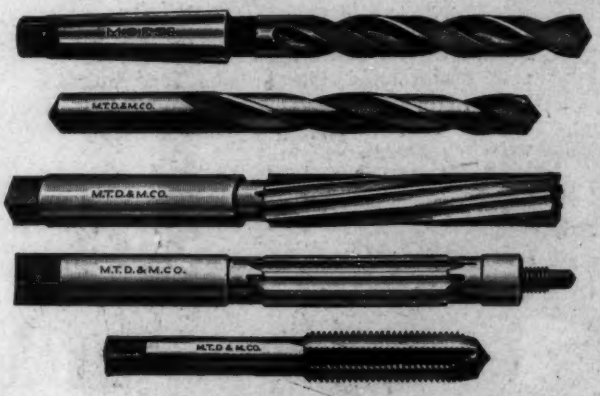

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MORSE STRAIGHT SHANK DRILL
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MORSE EXPANSION REAMER
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SPIRAL POINTED HAND TAP
High speed and carbon steel. For machine tapping of most common materials in through holes. Furnished in plug style only.

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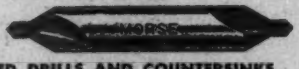
MORSE HEAVY DUTY HIGH SPEED END MILL
Coarse-toothed, spiral heavy-duty mill. Available in right-hand or left-hand types.



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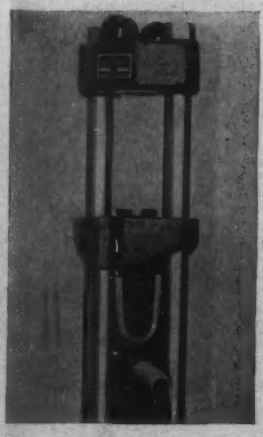
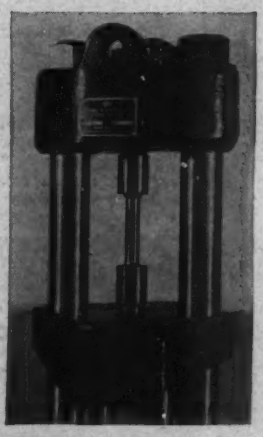


Making the Guided Bend Test using anvil and die supplied with the machine.



Longitudinal all-weld metal (0.505") test specimen being tested, using special jaws.

HERE'S a compact, accurate weld-testing machine that every modern school will welcome. Sturdily constructed, it provides a convenient means of obtaining accurate test data for qualifying student welders.

With this improved Airco machine three important tests can be made on standard test specimens — 1. Reduced section transverse tension tests; 2. Guided bend tests (a complete 180° face or root bend); 3. Longitudinal all-weld metal 0.505" tension tests. This is *the only portable testing machine available that combines all three functions in convenient, portable form.*

The machine operates on the principle of the hydraulic jack. Maximum direct load is 40,000 pounds, permitting tests on material of 150,000 psi. or higher tensile strength, by selecting the proper area for the test piece. A maximum hand mounted on the face of the gauge indicates the breaking load applied to the specimen.

The machine is packed in a strong oak carrying case with handles. Equipment includes the die and anvil for the guided bend test and jaws for the transverse tension test. Jaws for the longitudinal all-weld metal 0.505" test coupon are not furnished as standard equipment but are supplied on special order.

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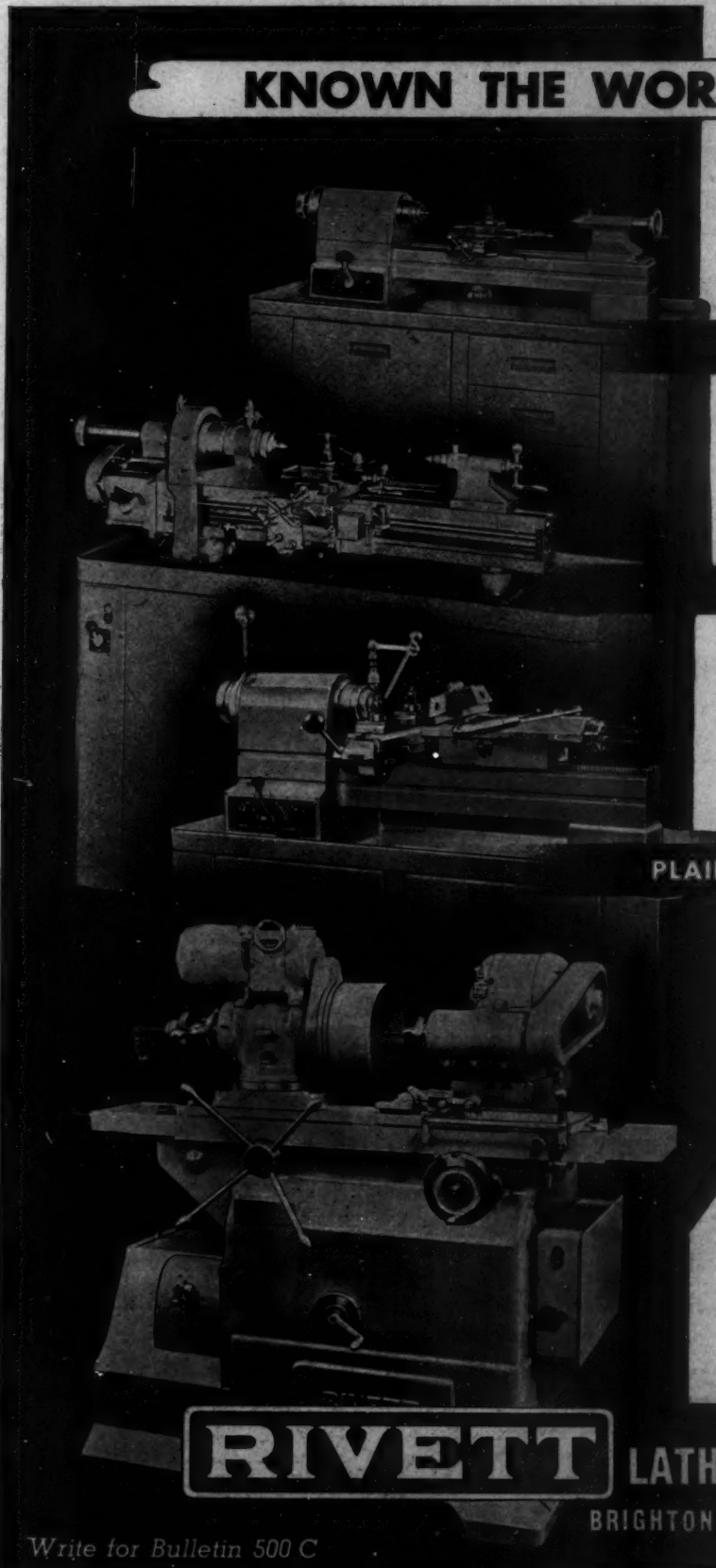

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No. 608 back-geared, screw cutting, precision lathe for production of fine work. It will handle a great variety of parts in minimum time. Finely made attachments for milling, spiral cutting, slotting, relieving, taper and ball turning, grinding, forming, and multiple operations are available. Swing 8½" dia.; center distance 18¼"; collet cap.: 1" max.

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No. 918 an efficient producer on small duplicate parts. In combination with six turret operations, double tool cross slide can be furnished for straight and taper turning, forming or cutting-off. Swing: 9" dia.; collet cap.: 1" max.

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Primarily for tool room work requiring wide variety of operations. Attachment for external grinding. Fine table feed with micrometer stop for shoulder and face grinding. In two sizes: No. 112, grinding cap. up to 8" dia.; table travel up to 8". No. 104, grinding cap. up to 3" dia.; table travel up to 4".

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Case History No. 204

The job was a tough one on files which were used to remove sharp edges from a bomber gun-port ring as it was spun in a bench lathe. Ordinary files quickly showed extreme wear.

On one of his calls, a Nicholson service engineer quickly solved the problem, both as to finishing results and from the standpoint of file-replacement costs.

A 10" Nicholson file for Stainless Steel,* in the Bastard cut, was tested on the job. It cut extremely well, and showed only a fraction of the wear of the files previously used.

IN THEIR travels up and down the vast fields of industry, Nicholson representatives are constantly running across instances where the advantages of using *The right file for the job* are clearly apparent—in better work and faster production. But they also find instances where the *wrong* file for the job is responsible for poor work—for which the worker, instead of the tool, is often blamed.

New metals, new products, new manufacturing methods make filing and file selection a never-ending study. Nicholson makes more than 3000 kinds, cuts and sizes of Nicholson and Black Diamond files. The place to gain an early understanding of their different characteristics and applications is in the school shop.

"FILE FILOSOPHY," the 48-page illustrated Nicholson book, affords a good beginning. It should be in every training-school library and on every technological instructor's desk. Have you all the copies you need? FREE.

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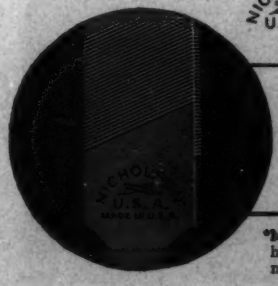

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*Mill Bastard for Stainless Steel—specially designed and hardened to resist abrasive action of hard chromium and nickel content of stainless steel. Stamped "For Stainless Steel."

The 1946 School Shop Annual

Fortunately, World War II is over and industrial arts and vocational education can look ahead hopefully with the expectation of progress in the years of peace ahead. Both industrial arts and vocational education have demonstrated their value during the hectic days, when our country was arming itself and its allies so that victory could be wrested from our enemies. Both of these fields of education demonstrated that they were especially valuable in educating people who have to live in a mechanized civilization.

Now that the war is over, the schools can again look forward toward bringing their building programs up to date, and toward acquiring the necessary equipment without waiting months and months for needed materials and labor to carry out plans that are long overdue.

With the prospect of building before us, it was thought expedient to furnish our readers with information that would be helpful in planning schoolrooms and school shops. Such information will be found in H. W. Paine's article entitled "Practical Factors in the Design of All Day Trade Schools."

A very necessary item in the design of a school building — whether it is to be used for straight academic work, or for a combination of academic studies and shopwork, is to provide sufficient suitable light to avoid undue eyestrain. For this reason William G. Darley's "Seeing in the Schoolhouse," was chosen specially for this issue.

Closely allied with proper lighting of the classroom and the school shop is the matter of the color used on walls, ceilings, and equipment. This phase of shop planning is well covered in Paul G. Hausman's article, "Contrast Color Painting for Shop Safety."

With the need for revising and enlarging industrial arts and vocational education courses, the following articles may be found helpful:

"Plans for Setting Up Vocational and Industrial-Arts Courses," by Floyd R. Love;

"A Revised Industrial-Arts Program," Frank W. Trella;

"An Industrial-Arts Expansion Program," by G. Wesley Ketcham;

"Essentials of an Instructional Plan," by J. W. Giachino.

Besides the foregoing material there are a number of course outlines and articles of a general nature that will be of interest to teachers of industrial arts and vocational education.

There also are a number of problems and projects which may be found useful in the school shop.

This Month's Cover

The photograph used for this month's cover was submitted by Harry E. Nesman to illustrate his article, "Michigan Offers Training in Agriculture to 'G.I. Joe,'" which appeared in the February, 1946, issue of INDUSTRIAL ARTS AND VOCATIONAL EDUCATION on pages 57 and 58. It shows a student securing firsthand experience in oiling and greasing a tractor. As is plainly evident, the farmer, who is supervising the beginner, is quite insistent that the job is properly done.

Industrial Arts and Vocational Education

THE SHOP TEACHERS' PROFESSIONAL MAGAZINE

Published monthly except in July and August

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Editorial Contributions. — The Editor invites contributions bearing upon Industrial Arts, Vocational Education, and related subjects. Manuscripts, drawings, projects, news, etc., should be sent to the Publication Office in Milwaukee. Contributions are paid for at regular space rates. In all cases manuscripts should be accompanied by full return postage.

Articles Indexed. — The articles contained in the Magazine are regularly indexed in "The Readers' Guide to Periodical Literature," and "Education Index."

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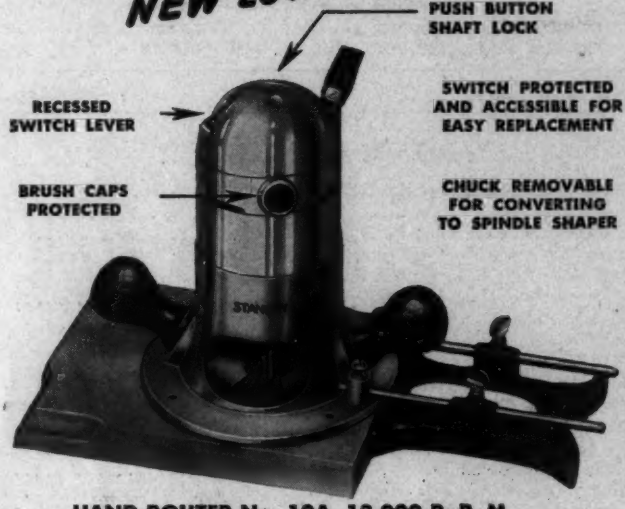
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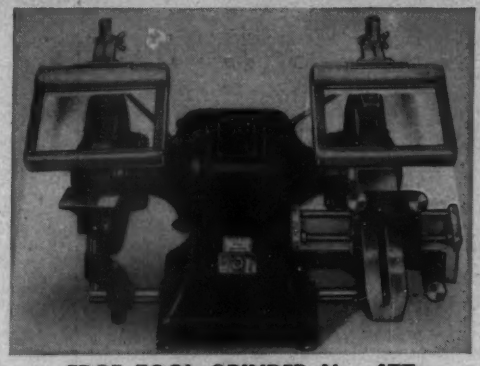

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Ideal for the school shop. Ball Bearing, 7" x 1" wheels – one wheel specially designed for edge tool grinding, one wheel for general purpose grinding. Motor operates at slow speed. Equipment includes: Plane Iron and Chisel Grinding Fixture, "Flud-Lite" Safety Eye Shields. A.C. current, **$66.00**

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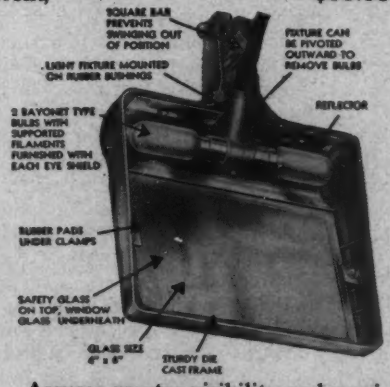
SQUARE BAR PREVENTS SWINGING OUT OF POSITION
FIXTURE CAN BE PIVOTED OUTWARD TO REMOVE BULBS
LIGHT FIXTURE MOUNTED ON RUBBER BUSHINGS
REFLECTOR
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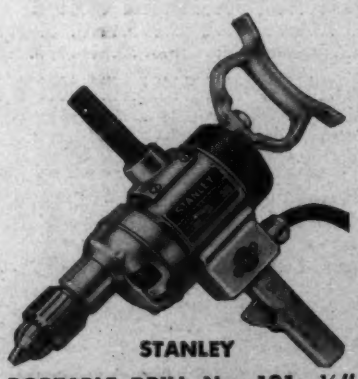

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Practical Factors in the Design of All Day Trade Schools

*H. W. Paine**

During November, 1945, bond issues for vocational school buildings which appeared on the ballots in numerous cities all over the nation were passed upon by the voters of America. In spite of the fact that on most ballots the vocational school building was only one of many issues, the bonds for these schools were approved in practically every instance. Furthermore the vocational bonds invariably led the field in percentage of ballots cast, in some situations securing the approval of from 70 to 90 per cent of the votes. Obviously, as far as the voting public is concerned, the rank and file of Americans are convinced of the soundness of the vocational-education movement as sponsored under the Smith Hughes Law of 1917 and the George Deen Law of 1936. It wishes to see that this educational movement is given every posible facility to carry out its objectives of preparing competent self-supporting citizens for our American industrial democracy and of upgrading its employed workers.

Educators who have been skeptical of the permanence of the movement or of its right to a place in the American educational scheme of things, would do well, to re-evaluate dispassionately the contributions of vocational education to the nation's welfare in the past quarter of a century, and particularly its magnificent service to America during the war emergency. They should ask themselves if the percentages of votes aren't indicating a ground swell of public sentiment for modernizing and Americanizing our country's educational system that is destined to sweep all opposition aside. Is it not evidence of a crystallizing determination to demand and to secure a more logical, a more democratic, a more serviceable educational system for American youth? Be that as it may, November's electoral confirmations of bond issues are now mandates to our educational leaders to convert the monies voted into brick and mortar and steel, into shops and laboratories and classrooms, into adequate, common-sense facilities for the effective preparation of America's future wage earning tradesmen, citizens.

Objectives of this Article and Sources of Materials

Briefly, the objects of this article are to provide some basic philosophies underlying vocational housing and to present common-sense suggestions for developing efficient, economical, and flexible buildings. Much of the material presented was produced by members of a vocational teacher-training class who were working in committees to assist in developing tentative shop, laboratory, and classroom layouts for Cincinnati's proposed new vocational school. No claims are made that the approach is scientific or even systematic, or that all the solutions to all the problems involved in vocational school building will be found in the following pages. However, many worth-while suggestions will be found as to lines of attack, possible room and equipment arrangements, and other matters of interest to planners in this field. While most of the data presented concern the large city building program, many suggestions are pertinent to any building program, and several floor plans of vocational buildings in the smaller city vocational units are submitted to show possible room arrangements in such situations.

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Shop and related classroom design and layout class

Decisions that Must be Made in Planning a Vocational Building

Obviously the first step in planning any vocational building, or for that matter any school building, is to make final decisions as to what is to be taught; and second, to determine the numbers and classes to whom it will be taught. The first decision must include the settlement of the problem as to whether or not one school building is to serve the needs of both boys and girls. In many cities separate vocational schools are provided; in others, both groups are housed in one building. A very satisfactory solution was attained in Toledo, Ohio, where the girls' vocational school is a separate unit, but is located immediately across a narrow, little-used street from the boys' school. This enables one large auditorium to serve the needs of both schools for special functions. Also, afterschool and evening social events are easily arranged. The arrangement seems to present all the advantages of a coeducational system, socially, but is free from most of the problems that accompany housing both programs in one building. In the smaller cities where the vocational activities are carried on as departments of a senior high school, the building program usually concerns supplying additional shop and related-subjects, laboratory and classroom space by erecting an attached building or one closely adjacent to the existing high school. In this case one of the chief problems faced by the administration is to resist all sorts of pressures to include extraneous and nonvocational *activities* in the new building. Suggestions will cover the inclusion of "a new and better cafeteria for the whole school," "an auditorium," "a band room," "all the industrial arts shops of the school." Often it is difficult for the superintendent to convince the many "special pleaders" that, after all, the taxpayers had voted funds for a vocational building in good faith, and that complying with these varied demands, even if he had any desire to do so, would entail practical misappropriation of public funds. These are only a few of the problems which face administrators who are improving their facilities for vocational education in our smaller communities.

The Attack on the Actual Building Design

Obviously before any planning is done the administrative and vocational staff with the assistance of an advisory committee should have thoroughly checked their going vocational program against the present existing needs of their community. If necessary, surveys should be inaugurated to validate the present offerings and to disclose needs for additional training activities that should be planned for in the new housing. These surveys should be made for both boys and girls training areas and in the case of the girls, special attention should, of course, be given to possibilities in such areas as cosmetology, commercial foods trades, and distributive occupations, in addition to the usual areas of vocational home economics, business training and the needle trades.

Planning committees at work

After the various trade fields have been decided upon, the next step is to determine the grade levels in which the work will be offered. This decision is based upon many factors.

Choice of Grade Levels

First of all, vocational education of the all day or unit trade type should be considered as "terminal education." In most cases it is preliminary to actual employment in a skilled trade and is as much a capstone of the pupil's educational preparation for life as the medical college years and law training are the educational capstones for the medical and law student.

With this in mind, it is quite evident that the final choice of the trade field (to be intelligent) should be delayed as long as possible, but should still leave time for adequate training before graduation. With the probable labor market of the next few years barring young workers under 18 in most worth-while trades, and with the further consideration in mind that sound vocational education should be built upon sound general education, especially in the fields of mathematics and science, as well as upon sound choices, it is quite evident that most vocational curriculums should be laid out in grades 11 and 12; or 11, 12, and 13 for highly technical fields. Grades 9 and 10, in so far as possible, should be devoted to tryout, exploration and guidance, and to the building of firm backgrounds in the physical science and mathematics, at least in the mechanical trades. The shops should provide for broad basic training in various trade fields and should stress fundamentals and exploration rather than trade development.

Another important factor controlling the choice of vocational grade levels is the particular secondary educational pattern of the city. If the city program is operating on the 6–3–3 plan, that is, if the city has a fully developed junior high school system, the logical grades to be included in the vocational high school would be 10, 11, and 12 with grade 10 allowing opportunities for shifting from shop to shop if so desired and also providing a sound basic preparatory foundation for the strictly vocational work in grades 11 and 12. If on the other hand, the city is organized on the 8–4 plan with 4-year senior high schools, the vocational school should also be a 4-year school with the first two years allowing opportunities for a general education, and with sufficient shopwork to give a sound basis for intelligent selection of one vocational trade field at the end of grade 10. If at the end of grade 10 the student has decided that vocational education is not for him, if his aptitude and interest lie elsewhere, he can transfer out to either a college-preparatory high school or to a general high school without a loss of credit. In certain cities the vocational school has tried to operate with its grades on the tenth, eleventh, and twelfth levels while the other schools are on the conventional senior high school four-year plan with grades 9, 10, 11, and 12. Under such conditions the vocational school is greatly handicapped in securing enrollments. The plan is illogical because ninth-grade students in the general high schools who are interested in vocational education often fail to transfer to the vocational school at the end of the year. They form friendships and school loyalties of various kinds that militate against changing schools. Furthermore under these circumstances the administrative and guidance staffs of the general high school may be inclined to view the vocational school as a competitor trying to proselyte students. Students making tentative choices of the vocational school are often "advised" to change their decisions. On the other hand if the student is doing failing work in the ninth grade he may be "advised" to transfer to the vocational school at the end of that year. Obviously a vocational school should not be viewed as a *competitor* of general education, nor a *"wastebasket"* for it; neither is it a reform school. It should be an integral part of the whole educational program of the city. It can only serve the needs of normal boys and girls who have special aptitudes, interests and abilities, who have made definite choices of their life's work and who are not planning on a college career. The grade levels of the vocational school must be so chosen that it can dovetail into the local pattern of senior high school organization. The foregoing points have been discussed at some length since a common-sense view of the vocational building program demands that intelligent decisions must be made regarding the grade levels to be housed in the building.

The Occupational Training Problem

The matter of offering occupational training for ungraded students should be decided before the actual building planning is started. If the city has a program for its low I.Q. and backward, older students that is meeting their needs, all well and good. However, if their occupational training needs must be taken care of in the new vocational housing in addition to the needs for vocational education of normal boys and girls, the problem should be met honestly and courageously. A separate department should be provided in which the low I.Q. students can be taught the lower skilled trades or parts of trades in occupational training classes. They no more fit into the standard all-day vocational trade school pattern with its requirements for mastery of the skills and broad related technical knowledge of a trade field, than they did in the general high school. Their needs should be met, for obviously, democracy in education doesn't mean the same or identical education for everyone; it means optimum opportunity for each to develop *his* particular abilities to the utmost. A city's educational setup should make provisions for the less gifted, honestly and thoroughly, and not evade the responsibility by assuming that either general education or vocational education is the solution.

Tentative Decisions for the New Building

Getting back to the actual building program, after deciding upon the trades to be taught and the grade levels involved, we must crystallize the curriculum for each trade. We can then analyze the building needs in the light of what is to be taught. We shall assume that grades 11 and 12 are the strictly vocational grades, the ones devoted to the direct preparation of the students to enter the trades as advanced apprentices. The pattern of the curriculum for each trade as planned to meet state and federal standards will be substantially as outlined below, using the machine trade as an example.

Grade 11 — Machine Trade

	Hrs. per week	*Credit*
Practical Work		
Machine-shop practice	15	1½
Related Subjects		
Machine mathematics	4	1
Machine science 3	3	
Machine blueprint reading	2	1
Other Subjects		
English	4	
Physical education	2	1
Total	30	4½

Grade 12

Practical Work		
Machine-shop practice	15	1½
Related Subjects		
Machine mathematics	4	1
Machine drafting	2	

	Hrs. per week	Credit
Machine organization and management	3	1
Other Subjects		
American history	4	
Physical education	2	1
Total	30	4½

If a week about shift between shop and related subjects is used, that is, one group of students engages in shopwork a week, while another group takes the related and general subjects and then the groups shift, some additional flexibility can be brought into the related subject fields. A condensed version of the week about shift as practiced in grades 11 and 12 of Central Vocational High School, follows. It should be pointed out that the twelfth grade is organized on a unit trade or all-day basis in this chart. If the twelfth grade is co-operative, as is the case in many of our vocational programs, the use of shop facilities by the twelfth graders will be somewhat reduced since the students will be securing the major portion of their training in skills on their jobs with a corresponding reduction in the use of school shop facilities. Nevertheless, the shop planning should provide shop facilities on the basis of all-day twelfth-grade classes since in years of labor surpluses the co-operative plan may have to be abandoned temporarily or greatly curtailed in favor of the all-day plan.

Regardless of whether the program is on the half-day shift or alternate week shift, the room requirements will be the same. Thus 2 machine shops would provide for two groups for each grade, one group working three hours in the a.m., and the other three hours in the p.m. — or on a week about shift. A machine science laboratory, a drafting room, and a standard classroom or two for the related mathematics, English, organization and management, and American history completes the picture for this curriculum with the exception, of course, of the physical education activities.

Now if grades 9 and 10 are to be operated on a nonvocational basis as discussed in the preceding paragraphs, additional facilities must be provided in all areas. The machine-shop requirements for these nonvocational grades are naturally less than for the vocational program, and the equipment should be simpler and more basic in character. However, the numbers involved are always greater in the beginning classes. A picture of the work covered

CENTRAL VOCATIONAL HIGH SCHOOL
Two Years — Basic Preparatory
Aeronautics — Automotive — Air Conditioning — Allied Construction Communications — Diesel-Electrical-Machine Design Patternmaking — Refrigeration

Tenth Grade 39 Weeks Subject	Semesters 1 Hrs.	2 Hrs.	Crs.
Required Subjects			
English II	5	5	1
World history	5	5	1
Mechanical drawing	5		½
Geometry		5	½
Physical education	3	3	¼
Activities	2	2	0
Shop Subjects			
A — Electrical	10	10	1
B — Internal combustion engines			
C — Machine			
D — Sheet metal			
E — Woodwork & model making			
A different shop should be elected each semester			
Totals	30	30	4¼

Ninth Grade 39 Weeks Subject	Semesters 1 Hrs.	2 Hrs.	Crs.
Required Subjects			
English I	5	5	1
Practical mathematics & algebra ..	5	5	1
General science	5	5	1
Music	1	1	0
Physical education	3	3	¼
Activities	1	1	0
Shops & Blueprint Reading			
A — Electrical	10	10	1
B — Internal combustion engines			
C — Machine			
D — Sheet metal			
E — Woodwork & model making			
A different shop should be elected each semester			
Totals	30	30	4¼

CENTRAL VOCATIONAL HIGH SCHOOL
Two Years — Vocational
Machine

Eleventh Grade 39 Weeks Subject	Semesters 1 Hrs.	2 Hrs.	Crs.
Practical Work			
Machine-shop practice (Alternate weeks)			
Machine & benchwork	30	30	1½
Related Subjects			
Machine mathematics	8	8	¾
Machine science		10	½
Machine Blueprint Reading & Drafting	10		¼
(Alternate Weeks)			
Other Subjects			
American history & citizenship	8	8	1
Physical education	4	4	¼
Extracurricular activities			
Totals	60	60	4¼

9 Weeks — Nine additional weeks in summer are required of co-operative students

Twelfth Grade 39 Weeks Subject	Semesters 1 Hrs.	2 Hrs.	Crs.
Practical Work			
Machine-shop practice (Alternate Weeks)			
Machine & benchwork	30	30	1½
Related Subjects			
Machine mathematics	8	5	½
Machine metallurgy		8	¼
Machine Blueprint Reading & Drafting	10		½
Machine organization & management		5	¼
(Alternate weeks)			
Other Subjects			
Practical English	8	8	1
Physical education	4	4	¼
Extracurricular activities			
Totals	60	60	4¼

in these beginning grades is revealed by the curriculum taken from Central Vocational High School's program of studies for grades 9 and 10.

These grades demand beginning shops that parallel rather than duplicate the trade shops of the upper grades where industrial type equipment, housing, and production attitudes are of paramount importance. The laboratories should be designed and equipped for the teaching of the physical sciences, and classrooms for algebra, English, civics, etc., can follow rather standard lines. Drafting rooms should be provided for the teaching of elementary formal mechanical drafting.

If it is deemed advisable to provide facilities in the vocational-school building for the occupational training of the retarded low I.Q. students not fitted for the regular vocational curriculums, whose problems have already been briefly touched upon, space must be allotted for this work and plans must be made for equipment and activities. Two things should be kept in mind; first, the jobs to be taught to this group should be in the semi-skilled and lower skilled areas; they should require little related learning and the greater portion of the learner's time should be devoted to shop activities. Second, exploratory values should be kept in mind so that pupils showing marked ability and interest may be transferred into the regular vocational classes to take advantage of the far richer and broader preparation for the skilled trades offered by vocational education.

An excellent article on this subject, describing an occupational training program offered in the Norwood, Ohio, schools appears in the September issue of *Ohio Schools*. The article is written by Fred E. Tipton of the Norwood Schools and describes an experimental program of occupational training being carried on in that system.

Determining Probable Enrollments

With the trades to be taught decided upon, and the various curriculums, grade levels and courses "crystallized" as it were, the next step is to estimate the probable numbers to be accommodated by the new building. In general, the trend seems to be to provide housing for from 50 to 100 per cent greater enrollments than the present going programs. This is probably logical for the following reasons: (1) Our present vocational school enrollments can be considered below normal on account of employment and other conditions brought about by the war; (2) the present widespread interest in the vocational educational movement will in itself bring greater enrollments; (3) new housing always attracts students that would not have attended inadequately equipped and poorly designed vocational schools; (4) parental opposition to their children attending a vocational school will disappear when it is fully realized that the training is for normal boys and girls and that the tryout and exploratory opportunities in grades 9 and 10 provide ample opportunities for wise choices of one's life work and that sufficient general education is secured in these two grades to give sufficient credits for college entrance when combined with the vocational credits of grades 11 and 12. Obviously, the responsibility of a vocational school is not college preparatory, but with the arrangement previously outlined, any student changing his mind upon graduation and desiring to enter a college of the engineering type should be able to do so with little or no summer work previous to entrance.

Even with provisions for doubled enrollments in vocational schools the percentage of the high school population in such schools will be small compared with that enrolled in general, college preparatory, and cosmopolitan high schools. Furthermore, America is becoming more and more industrialized as a nation. Greater opportunities for satisfying careers as tradesmen are developing every year.

Use of Advisory Committees for Suggestive Materials

Before this point in the housing program has been reached, the wise administrator will have appointed many advisory committees to analyze and crystallize the many points we have been discussing. Committees of vocational teachers will be called upon to make tentative laboratory, and classroom layouts to guide

Shows use of cutouts on scaled cross-section paper

the architect in the actual planning of the building and its facilities. The vocational staff of any large vocational high school contains individuals who know both the industrial and educational sides of their trades. They know the room sizes and what is more important, the *room shapes* that fit their trades. Auto-mechanics, and aero-repair shops must have width if work on actual automobiles and planes is to be carried on. Furthermore auto shops should have *wide, high* doors and if possible two doors in the shop devoted to service work. Aero-repair shops, especially the ones devoted to plane repair should be located in the end of a wing of a building. It will probably have to be a one-story shop so that its full width, preferably 60 to 80 feet, can be free of posts. The end of the shop should be *all* doors like an airplane hangar and should open upon a broad concrete apron. Only vocational teachers should be expected to possess such information. Architects can't know everything and must have help in the many technical problems involved in laying out a vocational building.

Taking a specific example — Cincinnati is entering the planning stage for its new vocational school with committees working on all phases of the problem. Dr. Courter, superintendent of schools, assigned the responsibility of heading up the city-wide building program to his Assistant Superintendent, John T. Herrick, who has set up committees for various phases of the program, headed by the local director, the principals of the vocational schools, and heads of departments. These committees have been functioning for some time.

University Co-operation in Vocational Teacher-Training Classes

To contribute further to the actual layout of shops and laboratories, the department of vocational education, of the University of Cincinnati, as the co-operating agency of the State Board for Vocational Education, Division of Trades and Industries, is offering a vocational certification and college credit course entitled, "Shop and Related Classroom Design and Layout." Some 26 teachers, and co-ordinators (with one tradesman) are enrolled in this group which is divided into committees that are working upon their separate problems. Since most members of these committees are also members of the city-wide committee under Dr. Herrick, their work can be most helpful in the general picture.

The activities of the class committees are mostly research and direct planning. Class time is devoted to reports and conferences, by groups, and "of the whole."

The assigned work can roughly be said to be "to rough out what we need, find out what other people have done, eliminate their mistakes in the light of our needs, and arrive at final conclusions."

Plans and bulletins, blueprints, magazines, all contribute to the work. Frankly, the most help comes from publications such as the Equipment Annuals of the *Industrial Arts and Vocational Education* Magazine, the *School Board Journal*, from plans and blueprints of successful vocational schools such as Macomber Vocational High School and Harriet Whitney Vocational High

School for Girls of Toledo, Ohio; Timken Vocational High School of Canton, and many others. A recent bulletin published by the University of the State of New York (1944) entitled *Industrial Education for Girls and Women* has been particularly helpful. Englehardt's *Survey Field Book for Analysis of a High School Building* published in 1931 by Teachers College, Columbia University, has been used as a check on certain phases of the building layout. In addition, state and federal bulletins dealing with safety standards, and with building and construction codes were studied.

Suggestive Data and Plans

Since the work of the teacher training class can be said only to be well started, no complete report can be made at this time of the work of the various committees.

Some of the points developed by various committees to date, regarding shop, laboratory, and related classroom details will be briefly outlined in that which follows. In addition, problems underlying the selection of post spacing as related to shop sizes, arrangements and plans will be briefly analyzed.

Automotive Repair

Each shop to accommodate 25 students.

Shop Classifications

1. Automotive service shop
2. Body and collision service shop
3. Beginning repair shop
4. Automotive electrical shop

Shop Details

1. Shop size — all shops 60 by 80 or 90 ft. (Should be located together.)
2. Service and collision service shops should have two outside doors each, 12 by 12 ft. Other shops, one outside door each, 12 by 12 ft. (Also hall doors 10 by 10 ft., and 3 by 7 ft. 8 in.)
3. Floors — concrete (treated)
4. Conference room (one for each shop, 18 by 20 ft., with blackboard, cabinets, file, teacher's desk, and tablet-arm chairs for 25 students)
5. Wash and locker room, 15 by 20 ft.
6. Tool room, 8 by 10 ft., next to conference room.
7. Bench space and vises. Benches along one side of room, equipped with 10 vises.
8. Overhead hoists on tracks in service and collision service shops.
9. Spray paint booth in collision service room only.

Notes: Locate all equipment so as to facilitate movement of cars. Provide electrical outlets, gas, air, water, in all rooms. Meet code specifications for storage of oils, lacquers, etc.; also for spray painting booth.

Aeronautics Repair

Shop Classifications

1. Engine repair shop
2. Airplane construction repair

Shop Details

1. Shop size — engine repair shop, 45 by 90 ft.; airplane construction repair shop, 60 or 70 by 90 ft. No posts.
2. Outside doors, Engine repair — one 12 by 12 ft. Airplane construction repair — hangar doors on whole end of shop, if possible, opening on concrete ramp or opening onto hallway apron. Also 10 by 10 ft. door opening onto hallway in addition to the standard 3 ft. by 7 ft. 8 in. door.
3. Floors — concrete (treated).
4. Conference rooms 18 by 20 ft., both rooms, same as for automotive-repair shop.
5. Wash and locker room 15 by 15 ft., both rooms. Same as auto mechanics.
6. Tool rooms, 8 by 10 ft. — both rooms.
7. Bench space and vises — along one side of each shop — 10 vises.
8. Overhead hoists — on tracks in both shops.
9. Spray paint booth. In airplane construction repair shop large enough to accommodate wings.

Notes: Locate all equipment so as to facilitate movement of planes, etc. Other shops, if necessary for beginning students, should be similar to engine repair shop.

Machine Shop

Shop Classifications

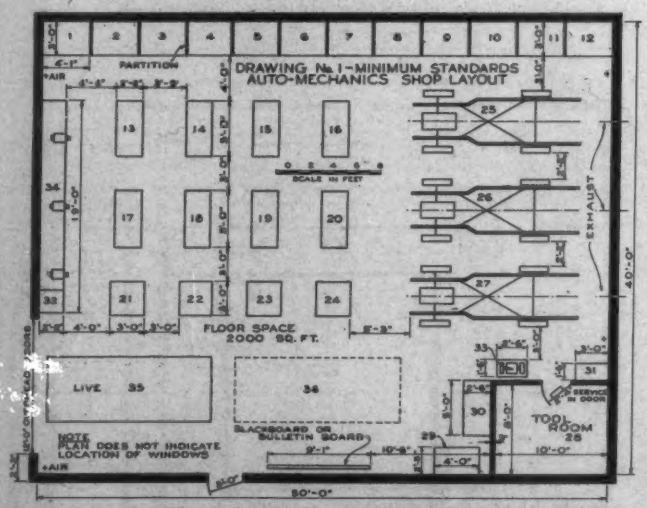
1. 1 advanced shop.
2. 1 intermediate shop
3. 2 beginning shops.

(To be adjacent to each other, if possible.)

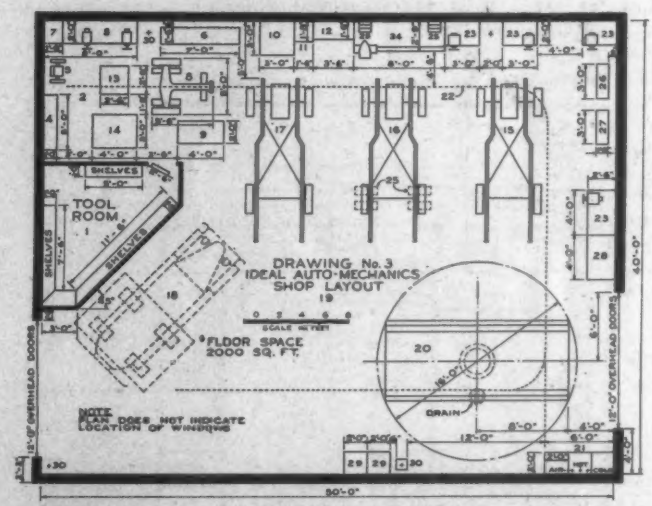
Shop Size

1. Advanced room, 60 by 90 ft.; intermediate room and beginning rooms, 45 by 90 ft.
2. Outside doors, same as auto repair shop. One 12 by 12 ft. on each shop. (Also 10 by 10 ft. and standard door opening onto hall.)
3. Floors — concrete (treated).
4. Conference rooms, 18 by 20 ft. for each shop, same as for auto-repair shop.
5. Wash and locker room, 15 by 15 ft., for each shop, same as for auto repair.
6. Tool room, 8 by 10 ft. for each shop.
7. Bench space and vises along one side of room — 15 vises.

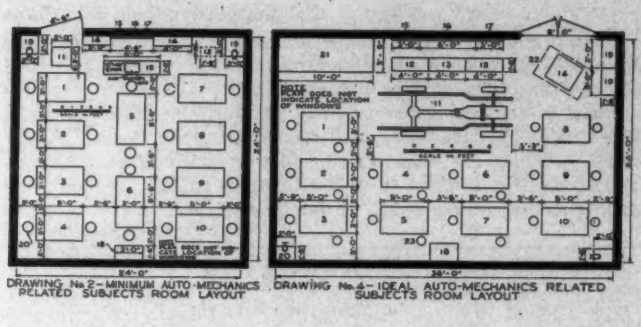
Notes on Location of Machine Tools



Floor plan for minimum standards auto-mechanics shop. 1. Generator, cutouts, voltage regulators; 2. starting motors, drives and controls; 3. distributor coils, condenser; 4. instruments; 5. wiring; 6. magnetos; 7. spark plugs; 8. Diesel fuel pumps, injectors; 9. fuel pumps (gasoline); 10. Carter carburetors; 11. Stromberg carburetors; 12. cutout gaskets; 13. Ford engine, external job; 14. Ford engine, internal job; 15. Plymouth engine, external job; 16. Plymouth engine, internal job; 17. Chevrolet engine, external job; 18. Chevrolet engine, internal job; 19. engine, miscellaneous; 20. Diesel; 21. transmission overhaul; 22. clutch, universal joint, overhaul; 23. rear axle differential, overhaul; 24. steering gear overhaul; 25. chassis, Ford, complete; 26. chassis, Chevrolet, complete; 27. chassis, Plymouth, complete; 28. tool and parts storage; 29. air compressor; 30. small engine lathe; 31. garage press; 32. small drill press; 33. grinder and wire buffer wheel; 34. workbench and vises; 35. space for live job and assembly; 36. space for live job and assembly



Floor plan for ideal auto-mechanics shop. 1. Tool and parts storage; 2. overhaul bay for unit repairing; 3. bench; 4. battery charger; 5. grinder and wire buffer wheel; 6. small lathe; 7. drill press; 8. rear axle overhaul stand; 9. valve reconditioning unit; 10. electrical test; 11. electrical test; 12. electrical test; 13. brake drum lathe; 14. engine repair stand; 15. fender body and painting; 16. brake front and headlights; 17. major overhauling; 18. motor tune-up (dynamometer optional); 19. general service and radio; 20. revolving hoist and lubrication and wash rack; 21. pressure washer and tubs; 22. chain block and track; 23. portable service benches; 24. headlights, testor portable; 25. brake testor and gauges optional; 26. welding outlet; 27. power bending unit; 28. lubricating equipment; 29. cleaning tanks; 30. air outlets

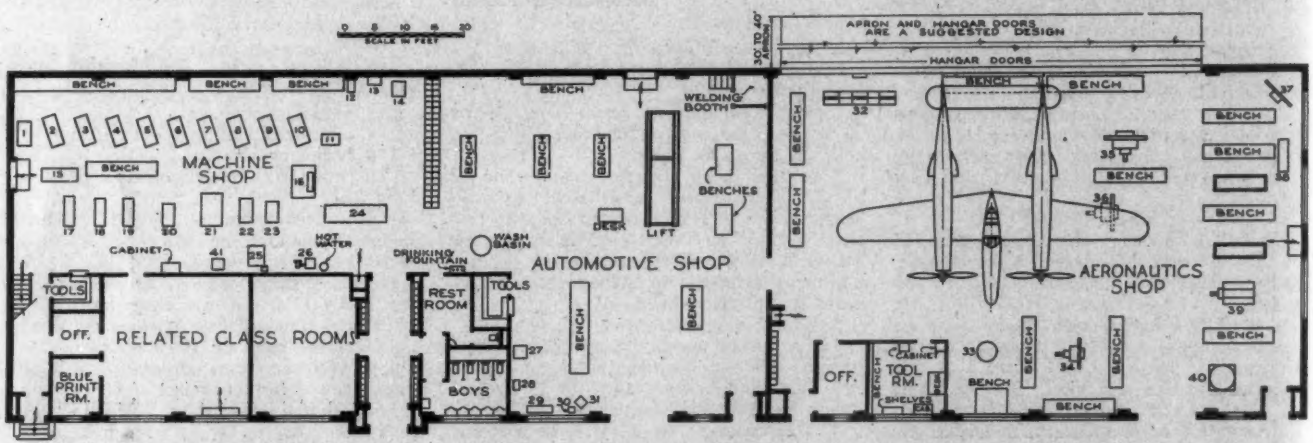


DRAWING No. 2—MINIMUM AUTO-MECHANICS RELATED SUBJECTS ROOM LAYOUT

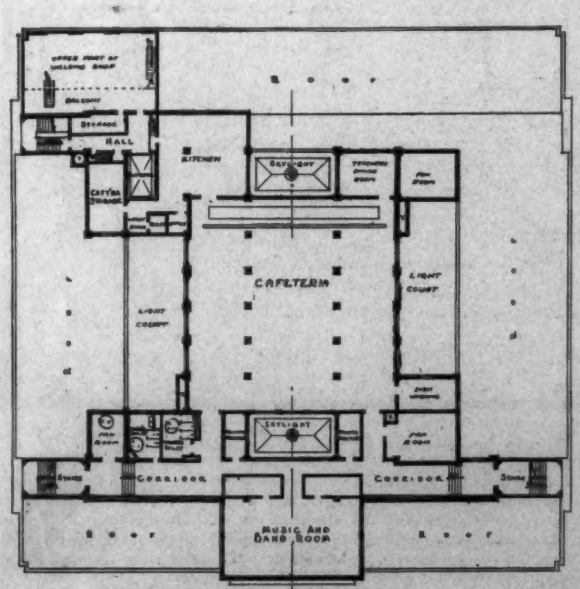
DRAWING No. 4—IDEAL AUTO-MECHANICS RELATED SUBJECTS ROOM LAYOUT

Drawing No. 2. Floor plan for training station. 1. Measuring instruments used in automotive trade; 2. work, power, friction; 3. mechanical levers, gears, belts, chains; 4. heat expansion; 5. vacuum, air, mechanical gases; 6. fuel, lubricating, minerals, liquid and testing; 7. electricity magnetism instruments; 8. lights, generators and starting motors; 9. mechanical hydraulics; 10. physics of electronics and radio; 11. electrical test bench, portable; 12. chemistry, physics, demonstration table (sink); 13. desk; 14. storage lockers; 15. blackboard; 16. screen; 17. charts; 18. projector; 19. benches, vises; 20. stools

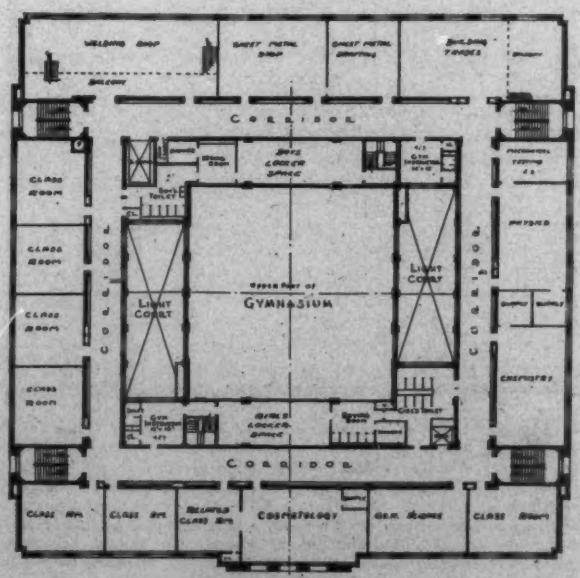
Drawing No. 4. Floor plan for training station. 1. Measuring instruments used in automotive trade; 2. work, power, friction; 3. mechanical gears, levers, belts, and chains; 4. heat expansion; 5. vacuum, air, and mechanical gases; 6. fuel, lubrication, minerals, liquid, testing; 7. electricity, magnetism and instruments; ignition; 8. lights, generators, and starters; 9. mechanics of hydraulics; 10. physic of electronics and radio; 11. cutaway chassis; 12. chemistry, physics, demonstration; 13. sink, air, water, gases; 14. electrical test bench, portable; 15. blackboard; 16. screen; 17. chart; 18. projector; 19. storage lockers; 20. small benches and vises; 21. probing dynamometer; 22. magnaflux operating (optional), portable; 23. stools



Vocational trades and industries — shop layout, Portsmouth High School, Portsmouth, Ohio. 1. Surface grinder; 2. 16-in. lathe; 3. 16-in. lathe; 4. 14½-in. lathe; 5. 14½-in. lathe; 6. 14½-in. lathe; 7. 14½-in. lathe; 8. 13½-in. lathe; 9. 13½-in. lathe; 10. 13½-in. lathe; 11. drill press; 12. drill press; 13. tool and cutter grinder; 14. grinder; 15. band saw; 16. bench with 10-in. lathe; 17. 13½-in. lathe; 18. 10-in. lathe; 19. 10-in. lathe; 20. milling machine; 21. shaper; 22. shaper; 23. drill press; 24. planer; 25. forge; 26. heat-treating furnace; 27. drill press; 28. grinder; 29. 8-in. lathe; 30. grinder; 31. valve grinder; 32. riveting bench; 33. Pratt and Whitney 985; 34. Pratt and Whitney 1830; 35. Pratt and Whitney 1830; 36. Pratt and Whitney 1340; 37. Allison engine disassembly; 38. Allison engine disassembly; 39. Allison engine disassembly; 40. Wright 2600; 41. heat-treating furnace



Roof plan



Fourth floor plan

Roof and fourth floor plan, Timken Vocational School, Canton, Ohio

1. Lay out by use of scale section paper and scale models.
2. Leave clearance space and easy access.
3. Provide for proper routing of work and for assembly floor space in advanced shop.
4. In locating lathes, angle *right* side of tailstock toward outside windows so as to receive light on headstock. When student lifts eyes he looks into darkened room, not into the bright outside light. Use similar precautions in locating other machine tools.
5. Provide overhead buss bar wiring with separate overhead cut off switches for each machine in addition to operating switch.
6. Arrange for quick travel by instructor to any part of shop.
7. Observe all safety and code requirements.

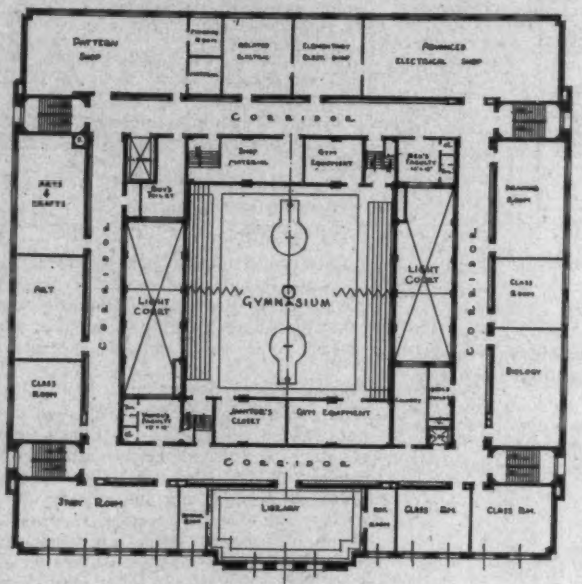
Welding Shop

Shop Classifications

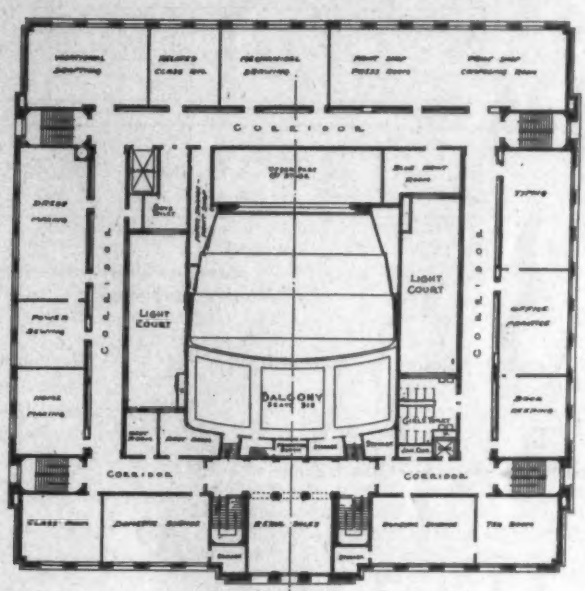
1. Welding is usually considered to be a tool of many trades, therefore students from machine, auto, aero repair, etc., will receive welding training as part of the shop experience of their trade. However the characteristics of the work are such that a separate well-ventilated shop should be provided for it.

Shop Details

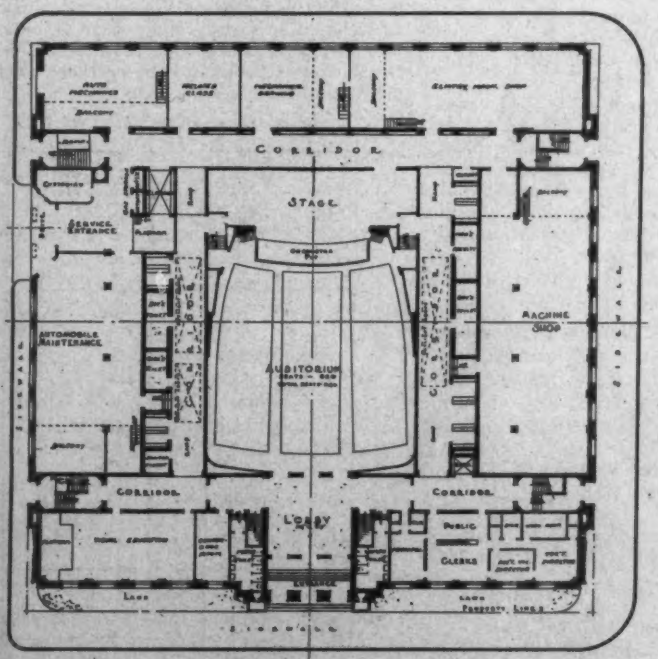
1. Shape and size of room, 45 by 90 ft.
2. Outside doors. One 12 by 12 ft. Also 10 by 10 ft., and standard door opening onto hall.
3. Floor — concrete (treated).
4. Conference room, 18 by 20 ft., same as for auto shop.
5. Wash and locker room, 15 by 15 ft., same as for auto shop.
6. Tool room, 8 by 10 ft., same as for auto shop.
7. Bench space and vises, 30 ft. bench with 5 vises.
8. Booths and equipment: Booths must be provided with curtains and ventilation for electric arc welding. Acetylene welding to be done on properly spaced firebrick-topped welding tables. Acetylene and oxygen should be carried to individual tables through overhead manifold system allowing housing of gas



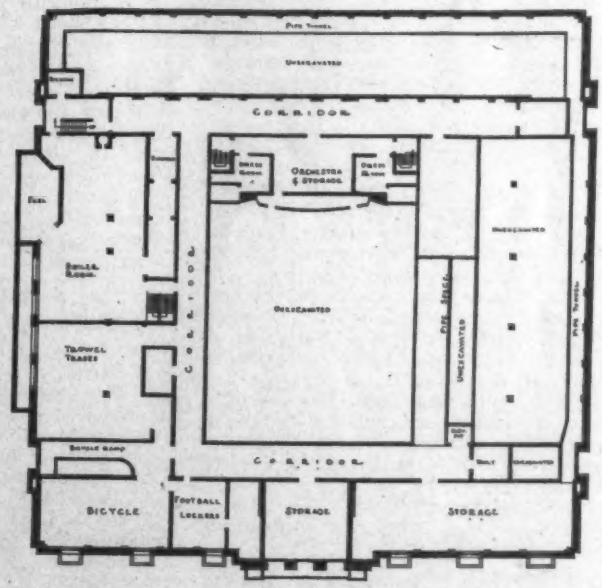
Third floor plan



Second floor plan



First floor plan



Basement floor plan

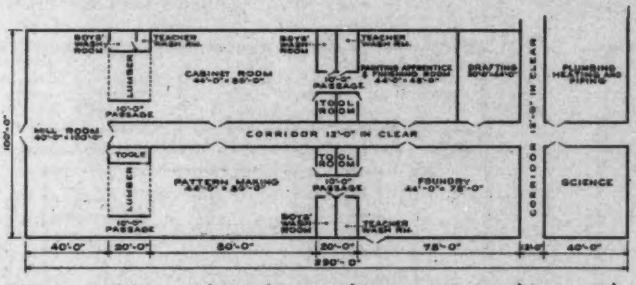
Basement, first, second, and third floor, Timken Vocational School, Canton, Ohio

containers in outside fireproof building or cabinet. Provide a few regulation standard, portable-type gas welding outfits. Provide overhead-buss-bar distribution of power for electric welders with separate switch for each unit in addition to operating switch. Use scaled section paper and scale models for layout purposes. Provide easy access to all parts of room.

Cabinet, Millwork, and Patternmaking

Shop Classifications

(1) Pattern shop, (2) mill room, (3) Cabinet shop. Note: If a foundry is to be included, it should be located next to the pattern shop.



Suggested layout for cabinetmaking, patternmaking, and allied trades shops

Shop Details

1. 45 by 90 ft. for millwork and pattern shop; 60 by 90 ft. for cabinet shop, with 20 by 30 ft. finish room. These rooms should be adjacent and so arranged that millroom containing most of the power equipment is located between the other 2 shops in order to rough out material for both. If foundry practice is to be taught, that shop should be located adjacent to pattern shop.
2. Outside doors, 12 by 12 ft. for each shop. Also 10 by 10 ft. and standard door opening onto hall.
3. Floors — wood.
4. Conference rooms, 18 by 20 ft. for each shop, same as auto mechanics, or adjacent shops may probably arrange to use one room.
5. Wash and locker rooms, 15 by 15 ft., same as for auto mechanics.
6. Finish room, 20 by 30 ft. in cabinet shop.
7. Tool room, 8 by 10 ft. for each shop.
8. Lumber storage-racks for mill room should be located close to outside door.
9. Workbenches — cabinetmakers' benches in cabinet shop and pattern shop.
10. Location of machine tools and benches. Use scaled cross-section paper and scale models to locate equipment and benches in all rooms. Provide proper working spaces around power equipment.
11. Shaving and dust collecting systems — equip all power equipment, and provide as short runs as possible to outside collector. Observe all possible precautions to control and isolate fire in collector area.

Printing

Shop Classifications

1. Composition room.
2. Press room.

Shop Details

1. Shop sizes — 45 by 90 ft.
2. Outside doors. For press room, 12 by 12 ft. Also 10 by 10 ft. and standard door opening on hall.
3. Floor — Battleship linoleum or plastic.
4. Conference room, 18 by 20 ft. for each room, same as for auto mechanics.
5. Washroom, 15 by 15 ft.
6. Stock room, 10 by 15 ft.
7. Dark room for composition room, 15 by 15 ft.

Equipment, for composition room — locate type cases, tables, photo equipment with scaled cross section paper and scale models. For press room — locate press-room equipment to facilitate production. Use scaled cross-section paper and scale models.

Electrical, Communications and Radio, and Beginning Electricity

Shop Classifications

Shops should be adjacent and will vary according to activity needs only.

Electrical shop should have provisions for house wiring practice.

Shop Details

1. Shop size, 45 by 90 ft.
2. Outside door, 12 by 12 ft. Also 10 by 10 ft. and standard doors opening on hall.
3. Floor — concrete.
4. Conference room, 18 by 20 ft. for each room, same as for auto mechanics.
5. Washroom, 15 by 15 ft.
6. Tool room, 8 by 10 ft. for each shop.
7. Equipment and benches.

When separate beginning-electric, advanced-electric, and communications shops are set up, the beginning shop should contain provisions for elementary wiring and experimental work. The advanced shop should contain house wiring and motor repair, while the communications and radio would include equipment devoted to those activities. Use scale floor plan models and cross-section paper for locating benches and equipment.

Girls' Work — Cosmetology

Shop Classifications

Two rooms.

Shop Details

1. Two rooms, 30 by 50 ft. with connecting conference room.
2. Floor — battleship linoleum or plastic.
3. Conference room, 18 by 20 ft. between the two classrooms.
4. Wash and locker room, 15 by 15 ft.
5. Supply room, 8 by 10 ft. serving both classrooms.
6. Equipment.

Locate with proper clearance spaces. Use scale cutout models and scaled cross-section paper. When distributive education is offered as part of the vocational program and a practice sales room is maintained to provide practice in counter and display work and sales technique, it is well to locate the advanced cosmetology shop where outside patrons may be received and wait for service, in close proximity to the practice sales room. This will provide opportunities to sell the school, as well as its products, to the visiting ladies.

Business Education

Shop Classifications

A complete setup would include a bookkeeping room, a stenography room, a typewriting room and a production laboratory that is a part of the typewriting room or is located between the typewriting room and bookkeeping room, depending upon the funds available.

Shop Details

1. Room sizes: Bookkeeping room, 30 by 50 ft.; stenography room, 30 by 50 ft.; production laboratory, 30 by 50 ft.
2. Floor — battleship linoleum or plastic.
3. Wash and locker room, 15 by 20 ft. (for 3 rooms).
4. Supply room, 8 by 10 ft., to be located in the production laboratory.
5. Equipment.

Locate typing tables, bookkeeping machines, etc., with cutouts and scaled cross-section paper. Arrange production laboratory equipment to facilitate handling of supplies and to give easy access to all parts of the room.

Related-Subjects Rooms

The related-subjects rooms in a vocational school fall into 3 classes: (1) rooms for subjects such as related mathematics, history, English, (2) the laboratory type rooms for automotive science, machine science, and (3) drafting and blueprint reading rooms.

Type (1) rooms present no special problems in design. A choice must be made between the conventional tablet-arm chair or desk-type equipped room and rooms equipped with tables and chairs. The latter type are preferably for vocational classes and although they should be slightly more roomy, they are well worth the extra cost. Macomber Vocational High School furnishes excellent exam-

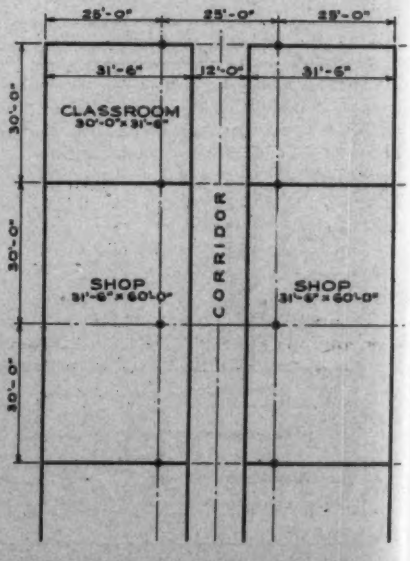


Fig. 1. Post spacing 25 by 30 ft. Longitudinal but narrow shops 31 ft. 6 in. by 60 ft. Classrooms 30 by 31 ft. 6 in.

ples of such rooms. The laboratory type rooms for a vocational school such as we are considering will vary in equipment according to the trade being taught. However, these rooms will have one thing in common; they should provide space for equipment and displays, and, in addition, provide an area for tablet-arm chairs at one end with blackboard space for class discussion. Such rooms will be approximately 40 by 70 ft., with linoleum floors. The test equipment and experimental tables should be located and spaced by the scaled cross-section paper and movable model method described for the shop equipment. In case of the machine science "lab," provisions should be made for metallurgical testing and heat treating. This will necessitate providing means of exhausting fumes.

General Comments on Building Layouts

In laying out the vocational building the architect must decide upon the spacing of posts to support upper stories and the ceiling unless a shop is to be a single story without posts. Where it is desired to lay out shops either side of a center hallway, the post spacing must be manipulated to give the room sizes desired.

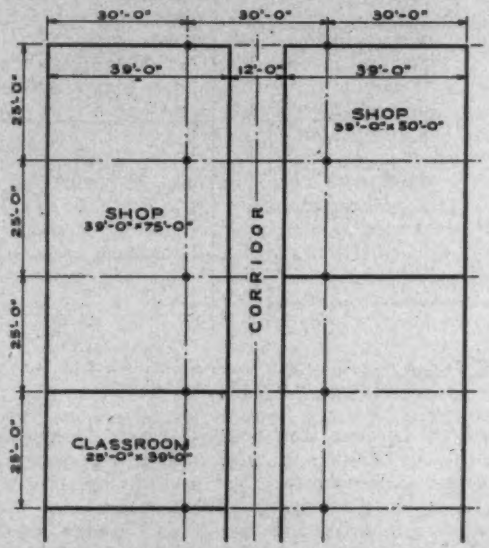


Fig. 2. Post spacing 30 by 25 ft. Longitudinal shops 39 by 75 ft., 39 by 50 ft. Using the same spacing as in Fig. 1, but setting up 5 bays as in Fig. 3, the shop widths become 56 ft. 6 in., and shops 56 ft. 6 in. by 60 ft., or 56 ft. 6 in. by 90 ft. can be provided

A central hallway, between the rows of shops, down which trucks may be driven to deliver materials to any room is a most convenient arrangement if access to the shops cannot be secured from outside areas. Figures 1, 2, 3, 4, and 5, show what can be done by different arrangements of the 25 by 30-ft. post spacing commonly used. Other possibilities are also touched upon. If it is desired to lay out the shop or classrooms either side of a corridor, say 12 ft. wide, laying out 3 bays will give rooms 31 ft. 6 in. wide (neglecting wall thicknesses). In other words, the room widths are too narrow for most shops, but this arrangement could provide excellent classrooms, 30 by 31 ft. 6 in. or narrow shops, 31 ft. 6 in. by 60 ft. Obviously longitudinal shops, or shops with their longer axes parallel to the axis of a wing of a building, will have much better natural lighting from the outside windows.

Laying out the centers with the 30-ft. spacing running transversely (not approved practice), the room width comes out 39 ft. See Figure 2. This arrangement would be satisfactory for most shops and can be used when it is desired to have the axis of the shop parallel the central corridor, or where classrooms larger than the 25 by 31 ft. 6 in. rooms, provided in Figure 1, are desired. Obviously shops 39 by 50 ft. or 39 by 75 ft. could be laid out with this design that would have excellent natural lighting characteristics.

With wall thicknesses and locker depths deducted from the room width, shown in Figure 4 there will be left effective widths between 65 to 66 ft. If a 25 by 28-ft. spacing were to be used and spaced as in Figure 4, the room width would become 64 ft. (without allowances for walls). Another arrangement of shops is to place their long axes perpendicular to the axis of the hall or wing as in Figure 5. Still using the 25 by 30-ft. post spacing we are able to develop greater flexibility in shop sizes; that is, if the partitions between shops are made of light steel and glass that can be removed at will, throwing two shops into one, three shops into two, or effecting other arrangements as changing conditions warrant. Incidentally, this arrangement, followed in the Macomber Vocational High School design, proved most effective and desirable.

The possibilities are shown in Figure 5. Using the 25-ft. spacing (transversely), shop lengths of 81 ft. 6 in. would be secured; by erecting the light steel and glass partitions on alternate post lines, as on the left side of Figure 5, shops would be secured of full 60-ft. width. Erecting partitions between selected rows of posts, 45-ft. widths could be secured, or 30-ft. if so desired. As previously pointed out this design lends itself well to securing flexibility in shop sizes and arrangements. If the post spacing were to be laid out on a 28 by 30-ft. center, the shop lengths in Figure 5 would be increased to 92 ft. If conference rooms and washrooms are included in each shop this 92-ft. length, secured by the 28-ft. bays, is very desirable.

If funds are available, and the large shops are carefully designed, the ultimate capacity of the building can be increased greatly by converting the single teacher shops into two teacher shops with doubled classes. Again, flexibility may be secured from year to year with varying enrollments in certain trades by converting some few of the shops to the two teacher double class arrangement. Providing all the floor space possible in shop

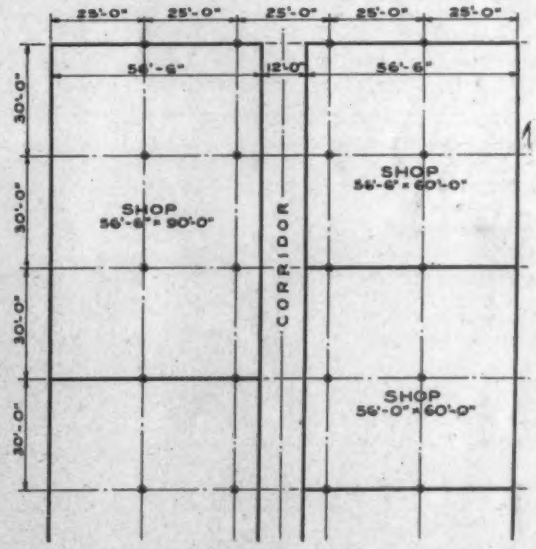


Fig. 3. Post spacing 25 by 30 ft. Longitudinal shops 56 by 60 ft., or 56 ft. 6 in. by 90 ft. Using the reversed spacing as in Fig. 2 but with 5 bays we may secure shop widths (or lengths) of 69 ft. (see Fig. 4), and larger shops 69 by 50 ft., 69 by 75 ft., or longer can be secured

planning practically always effects economy in the end. Figure 5 shows several shop arrangement possibilities to provide large floor areas.

Obviously, if the building is designed with several wings, different arrangements may be provided in different wings to meet the needs of particular shops. Drawings 1, 2, 3, and 4 are tentative plans worked out by different groups to show the possibilities of different arrangements.

Summary

In this article, the author has attempted to outline the underlying philosophy of vocational education as it affects the design and layout of new vocational high school buildings. A few of the many practical problems that must be solved before common sense designs can be effected for the different shops, laboratories, and classrooms have been touched upon with the hope that they will prove helpful to administrators and vocational teachers faced with converting the taxpayer's dollars into the best possible housing for the preparation of the future citizen mechanics of industrial America.

No attempts have been made to cover such problems as auditorium layouts, office plans, appearance and general arrangements of facilities. Such matters are far beyond the scope of this article which has been intended only to touch upon many of the very important problems that will vitally affect the efficiency of the teaching in the building. If it has pointed the way to the practical solution of these problems for the many communities now face to face with them in their individual building programs, the writer will be more than gratified. Much depends upon the prompt, efficient solution of these problems, perhaps far more than we realize. Finally the time to solve them is when the building is in the planning and design stage — not while it is being turned into brick and mortar and steel — certainly not afterwards, with regrets and inconveniences and high operating costs.

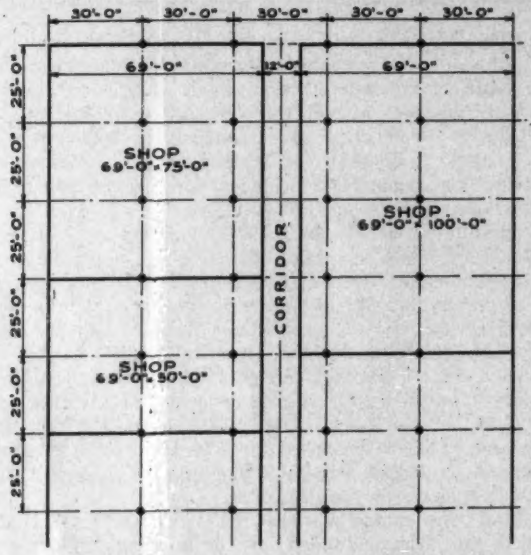


Fig. 4. Post spacing 25 by 30 ft. Longitudinal shops 69 by 50 ft., 69 by 75 ft., 69 by 100 ft.

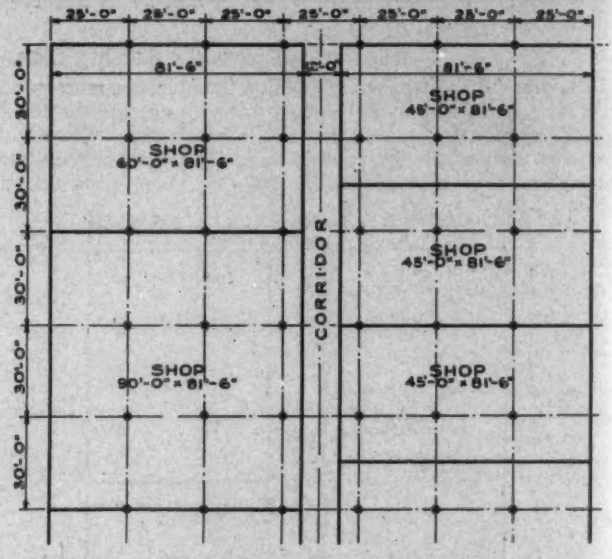


Fig. 5. Post spacing 25 by 30 ft. Transverse shops, 45 by 81 ft. 6 in., 60 by 81 ft. 6 in., 90 by 81 ft. 6 in.

Hangar at the Clover Park Schools, Pierce County, Wash. High school students have an opportunity, in this hangar, to become familiar with the latest types of military and commercial planes. Submitted by Carlin Aden, director of adult education

Seeing in the Schoolhouse*

*William G. Darley**

The science of illumination, or of brightness distributions for seeing, appears to have received its initial technical consideration in the 1700's. At that time Rumford[1] working with flame sources became concerned with methods of reducing the brightnesses of the sources in order to provide more comfortable seeing conditions. This study of the *quality of lighting* was a natural place to start, because glare in its primary form (a bright light source in the visual field) produces a relatively obvious effect upon the ease of seeing.

The effect of the *quantity of light* on seeing is much less obvious, particularly when illumination levels produce suprathreshold visibilities and the range of illumination available for study is limited. It was not until early in the 1900's, when more powerful illuminants were perfected and illuminations providing visibilities well above thresholds began to be used, that science became seriously concerned with the influence of the quantity of light upon seeing.

Since that time there has accumulated a vast store of knowledge regarding the influences of the quality of lighting and the quantity of light upon comfortable and easy seeing. In general, the information on the quality of lighting has pertained directly to the brightness of the source of illumination. Considerations as to the treatment (finish) of other surfaces in the environment have been largely limited to the influence that the finishes have upon the quantity of light reaching the working plane. For reasons which will be discussed later, this approach was acceptable as long as foot-candles[b] were of a low order. Recently, however, illuminations have been moving up to levels which make it essential to consider the finishes of surfaces in terms of their effect upon the brightness pattern of the environment.

Research has emphasized that for best seeing conditions the brightness of surfaces in the visual field when looking at the work should not be higher than, nor much lower than the brightness of the work. Thus to create modern, comfortable seeing conditions, those who would presume to prescribe natural and artificial lighting facilities for the schoolhouse must take into account the finishes of floors, furniture, chalkboard areas and trim, as well as take a more positive attitude toward the location of windows and desks and toward interior decoration generally.

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* Illuminating Engineer, Nela Park Engineering Division, Lamp Department, General Electric Company, Cleveland, Ohio.

[b] The light outputs of practically all lamps (light sources) which are used in the schoolhouse are expressed in terms of lumens. If these lumens are controlled so that there is a density on the working surface of 100 lumens per square foot, for instance, an illumination of 100 foot-candles results.

[1] All numerical references relate to books listed at the end of this article.

PART I

Factors Influencing Seeing

Seeing is influenced by a great many things. The most commonly appreciated factor has been the visibility of the material being viewed. Another factor which is rapidly coming to the fore as the dominant one is the visual comfort with which the task is accomplished. In general, the factors influencing visibility also influence eye comfort. It appears, however, that an evaluation of eye comfort is a more valuable criterion of the severity of a visual task than is a measurement of visibility, because discomfort may be experienced before visibility is adversely influenced in some cases. This is probably because comfort includes the element of time — that is, the duration of the period to which the eye is exposed to the visual task and its surroundings. With one or two exceptions, for instance, in the case of readability mentioned below, it can be assumed that an increase in visibility also results in a greater ease of seeing.

Size

Possibly the most obvious factor influencing seeing is the size of the object being viewed. Size is considered in terms of the visual angle which the object subtends. In the classroom, a 3-inch high character on a chalkboard intercepts a relatively large (14°15′) visual angle for the teacher at the board; with her eyes 1 foot distant from the board; however, for a pupil seated in the back of the room 26 feet from the board, the "size" of the letter is greatly reduced (to 33′), Figure 1. A common example of the application of "size" in connection with vision is the Snellen chart which is used by eyesight specialists to determine one's "seeing efficiency." Within certain limits, increasing the size of an object increases its visibility and the ease of seeing.[2]

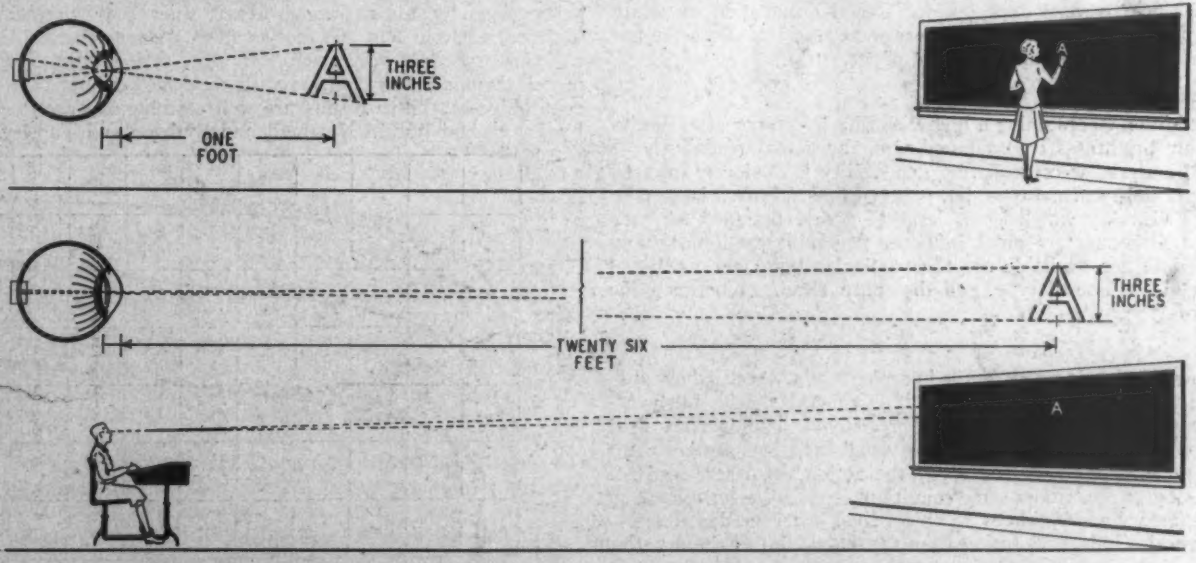


Fig. 1. A 3-inch character is about 4/100 as "large" when seen by the student at the back of the room as it is when seen by the teacher at the board. Note the relative area of the retina covered by the image of the letter in the two cases.

Revealing Brightness Contrast

The brightness difference between a letter and its immediate background which reveals the details of the letter is called *brightness contrast*.[3, 4] Since the black letters on this page are much more visible than white letters would be, it is obvious that it is desirable to have a high brightness contrast for high visibility and so for comfortable seeing. Since a high brightness contrast contributes materially to the visibility of an object, for clarity this type of brightness difference can be referred to as a *revealing*

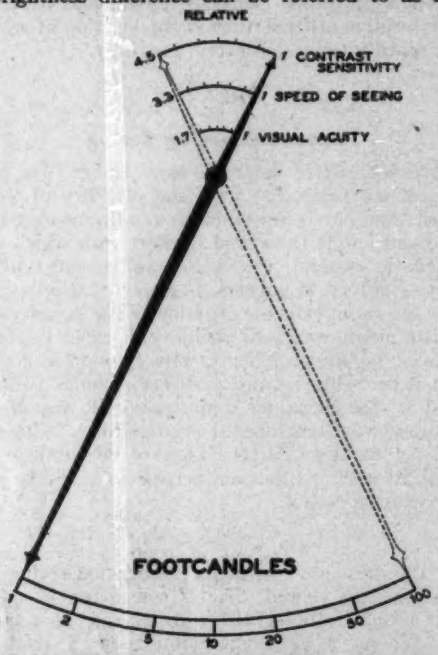


Fig. 2. A schematic presentation of the relative influence of level of illumination upon three fundamental visual functions.

brightness contrast. It is conveniently expressed in per cent.[c]

For some schoolroom tasks the brightness contrast between writing or printing and its background can be improved. Thus the use of soft pencils on white papers produces much more visible results than the use of hard pencils on colored papers. Again the use of black or very dark ink for stencil duplication on white paper produces material which is easier to read than does the use of lighter colored ink and off-white paper.

Readability

In addition to obtaining a high visibility by proper attention to revealing brightness contrast and size, the actual readability of printed material is controllable. Readability is obviously affected by the visibility of the type, but it is possible to have a large type of high visibility which is too large or poorly designed for easy reading. Other factors which influence readability and concerning which data are available are the particular type face used, the length of the line of type, and the space (leading) between the lines of type.[3]

Time

Time is a considerable factor in seeing.[5] If a wheel is held still, it can been seen quite easily. If it is rotated slowly, fairly accurate visual impressions can be registered. However, if it is rotated rapidly, it is found that the visual snapshots are not made with sufficient rapidity to "stop" the action. In other words, it takes time to see. Under some conditions it takes longer to register a satisfactory impression of an object than it does under others.

Time also influences seeing from the standpoint of the duration of the period to which the eyes are subjected to the visual task. There are some tasks in industry which are so severe that the

[c] Perfectly black print on perfectly white paper, or vice versa, would represent 100 per cent contrast.

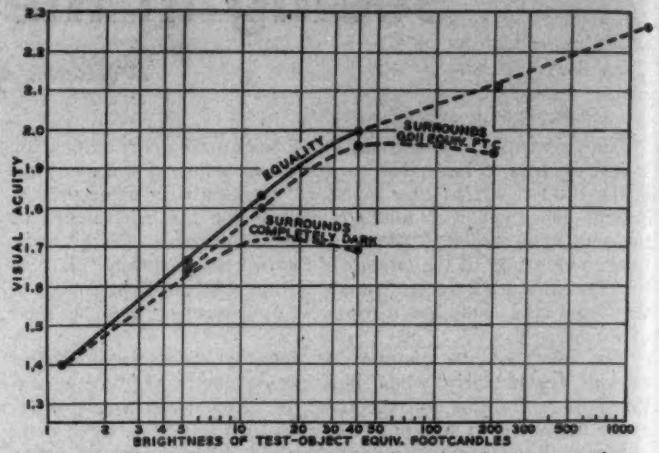


Fig. 3. The influence of surrounding brightness on the visual acuity versus illumination relation. For the two highest readings, the surrounding brightness was 38.1 equivalent footcandles (footlamberts).

operators are only allowed to work at them for 15-minute periods because of the eye effort involved. Hence, consideration as to how essential it is to improve the visibility or ease of seeing of a given task must take into account whether it involves intermittent or continuous application of the visual function.

Brightness

The brightness of the work is also a factor. Thus it is not uncommon for a person subconsciously to move toward the window when trying to see a difficult visual task indoors. Since in the average classroom there may be only 5 to 10 foot-candles in some parts of the room with possibly well over 100 foot-candles at the windows, a material increase in brightness is usually achieved by such a move.

Considerable research has been devoted to determining the interrelationships of size, brightness contrast, time, and brightness on visibility. Since in the classroom it is usually found that the size of the visual task is predetermined, that the time allotted for seeing should be held to a minimum, and that the revealing brightness contrast of the critical detail and its background is fixed, it is apparent that the influence most easily and most universally applicable to increasing the visibility of the task is brightness. Investigations by Luckiesh and Moss[5] show that increasing the illumination from 1 to 100 foot-candles increases visual acuity 70 per cent, speed of seeing 230 per cent, and ability to perceive objects having a low contrast with their background by 350 per cent (Fig. 2). These results are well corroborated by researches by Ferree and Rand,[6] Nutting,[7] and Lythgoe and Tansley.[8]

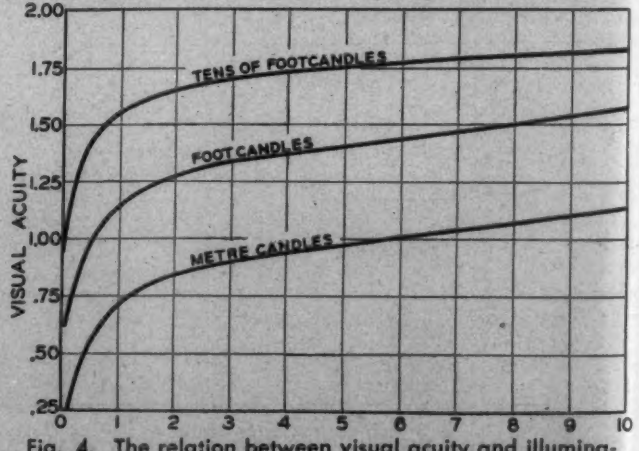


Fig. 4. The relation between visual acuity and illumination expressed on a linear scale using three different sets of illumination units.

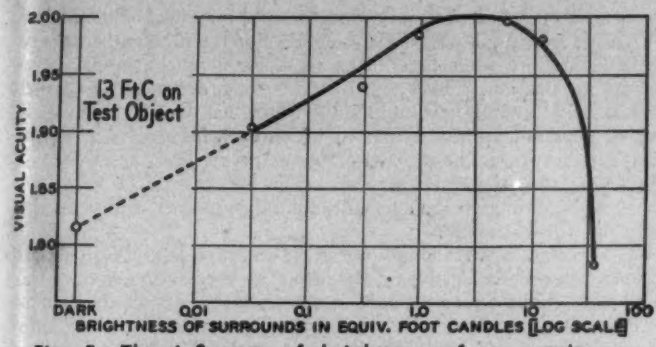


Fig. 5. The influence of brightness of surrounds on visual acuity with a constant brightness of test object.

Lythgoe[9] has carried studies of the influence of brightness on visual acuity to brightnesses above 1000 foot-lambert.[d] The top curve of Figure 3 (titled *equality* over the solid part of the curve) indicates the increments in visual acuity which Lythgoe obtained as the brightness of the test patch was increased above 1200 equivalent foot-candles (foot-lamberts). (These data were taken with the brightness of the test patch and the brightness of the surroundings approximately equal up to about 40 foot-lamberts. The brightness of the surroundings was held at this point as the brightness of the test patch was increased beyond it.) This finding has been corroborated by Moon.[10]

As a matter of interest, Lythgoe plotted data of visual acuity vs. brightness with the brightness values on Cartesian instead of logarithmic co-ordinates to illustrate why it is sometimes stated that visual acuity for detail does not improve much above 3 foot-candles. Lythgoe has the following to say about this matter:[9]

> There have been considerable disputes about the illumination at which the visual acuity is maximum, some workers putting it as low as 1 e-fc. (equivalent foot-candle or foot-lambert) and others as high as 7750 e-fc.[e] These huge differences are very probably due to the method of expressing results, as this should always be done with the illumination on a logarithmic scale. On such a scale equal distances along the illumination scale correspond to equal percentage increases in the illumination of the test-object. The graph relating visual acuity and illumination is a straight line, if illuminations are plotted on a logarithmic scale. It is very common, however, for workers to express their results in a linear graph connecting visual acuity and illumination (Fig. 4). Since the relation is approximately logarithmic, it follows that all they are doing when they plot their results to a linear scale is to plot a linear graph of a logarithmic function. The result obtained by such workers depends almost entirely on the country in which they happen to work. If they work in metre-candles,[f] visual acuity will appear to come to a maximum between 3 and 4 metre-candles. If they work in England with foot-candles, then visual acuity will appear to come to a maximum at about 3 or 4 foot-candles. On the other hand, if the work is being done by a modern American who thinks in terms of tens of foot-candles, then acuity is a maximum between 30 and 40 foot-candles. What these workers are really doing is to express a well-known property of logarithms. Looked at in this light, one can classify workers on visual acuity into those who work on a linear scale and get low values for the maximal brightness and those who work on a logarithmic scale and get a high value for the maximal brightness.

It is interesting to note that the reflection factor of some dark cloths is about 10 per cent. Thus to give this material a brightness of 1000 foot-lamberts would require 10,000 foot-candles — approximately the maximum illumination found outdoors with sunlight and skylight combined.

Disturbing Brightness Ratio

A brightness difference between the work[g] and its surroundings makes it more difficult to see the work, or is disturbing. This brightness difference is called brightness ratio.[3, 4]

Actually a brightness ratio is simply the ratio of the brightness of any two surfaces; however, it generally refers to the ratio of the average brightness of the work to that of some other surface in the surroundings. For instance, with overly bright luminaires in the field of view, the ratio of the brightness of the luminaires to the brightness of the work is high. For clarity, brightness differences of this type may be referred to as *disturbing* brightness ratios.

Lythgoe[9] found that when the surroundings are of a different brightness than the test patch, there are definite reductions in visual acuity. It will be observed in Figure 3 that the *rate of increase* in visual acuity shown by the top curve decreases materially when the surroundings cease to be equally as bright as the test patch (above 40 foot-lamberts). The middle and lower curves in Figure 3 further emphasize this point.

The "influence of brightness of surrounds on visual acuity" is also noted in Figure 5. This figure shows how with a constant illumination of the test object at 13 foot-candles, the visual acuity improves slowly as the surrounding illumination is raised to the level of the test object or a little below. When the surrounding illumination is raised above this point, there is a very rapid falling off in performance.[11]

Lythgoe and Tansley[12] have also shown that unfavorable (disturbing) brightness ratios reduce the sensivity to flicker — which is interpreted as meaning that they reduce the speed of seeing.

Cobb[13] has shown that high, disturbing brightness ratios reduce contrast sensitivity (Fig. 6). Cobb and Moss[14] showed that for a task consisting of setting two black pointers in vertical alignment through the turning of a hand wheel which moved one of them, the change from dark to light surroundings around the visual task decreased the magnitudes of the errors of alignment (Fig. 7). (It was also observed [Fig. 7] that marked decreases in the error of adjustment were obtained when the brightness of the white background [behind the pointers] was increased by increasing the level of illumination.)

High disturbing brightness ratios in the field of view require that the eyes go through the process of adapting[15] for the different brightnesses as the eyes follow a natural course throughout the field of view. The effort involved undoubtedly leads to fatigue and in nowise contributes to the better performance of the visual task. If the eyes are normal, they can stand abuse surprisingly well. On the other hand, if the eyes are subnormal and the seeing task is unnecessarily severe,[h] the added eye fatigue may reasonably cumulate into a more serious condition.

[d] If a surface emits or reflects (diffusely) 100 lumens per square foot, for instance, the brightness of the surface is 100 foot-lamberts.

[e] Reader advised to note p. 52 of reference.

[f] 1 metre-candle equals approximately 0.1 foot-candle.

[g] Composed of the critical detail and its immediate background.

[h] Because of the small size of details, or poor brightness contrast, or because the task is of long duration, or there is a poor brightness relationship with its surroundings, etc.

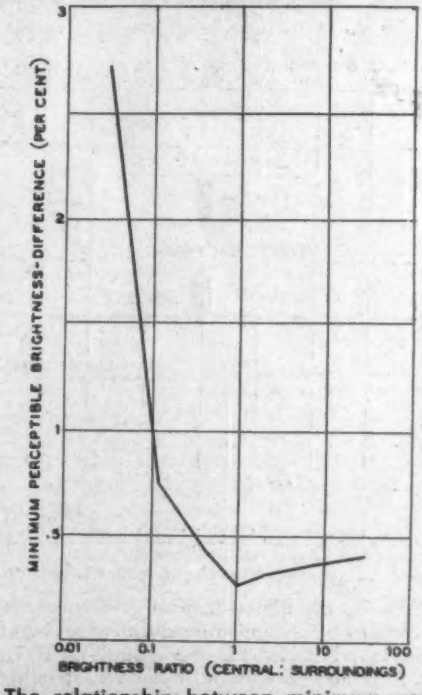


Fig. 6. The relationship between minimum perceptible brightness-difference and the ratio of the brightness of the central visual field to the brightness of the surrounding field. (Fig. 5.)

In previous recommendations for the lighting of schoolhouses, considerations of brightness ratios have been largely limited to the actual sources of illumination and their reflections, and when these were high they were said to be a source of *glare*. Glare is still a good term to apply to the deleterious effects of high disturbing brightness ratios. On the other hand, a full understanding of the influences of brightness ratios on seeing conditions is necessary to understand that glare is not a fixed thing. Hence, enclosing globes having a brightness of 1230 foot-lamberts (2½ candles per square inch) and bare fluorescent lamps having slightly higher brightnesses, are usually sources of glare when within the field of view for prolonged periods in the average interior. However, if these same sources were mounted out of doors in the daytime, with the brightnesses of the work and of the rest of the environment much higher than they are indoors, the "glare" sources would cease to be glaring, just as an automobile headlamp which is quite glaring at night ceases to be a source of glare in the daytime.

The concept of brightness ratios also broadens our appreciation of the things which cause glare. Common complaints, heard particularly about fluorescent lighting, are that the light hurts the eyes or that there is too much light. It is well established that the light from illuminants in common use today is not harmful to the eyes[16, 17, 18, 19, 20] and that even the best artificially lighted interiors result in brightnesses for the work and surroundings (with the possible exception of the light source) which are but fractions of the brightnesses of the outdoor environment. It is obvious that the difficulty lies with other than the spectral quality of the light or the level of illumination. Quite often it has been found that the complaint arises solely from high disturbing brightness ratios in the field of view of the individual, such as that which exists between white papers on black desk tops,[1] and has nothing to do with the light source itself. The level of illumination is involved only because at the higher levels brightness ratios which were tolerable at lower levels become disturbing.[21]

The Eye

During the major part of our evolutionary development, man's eyes were used principally during the daytime and for seeing things at a distance. Prolonged concentration on detail was not a requirement of existence for the vast majority of our early progenitors. At the same time, the eyes also developed the abilities to exert muscular effort to turn inward so that things could be seen up close when necessary, and to see a certain amount at low brightness levels. Man was not called upon until comparatively recent times to undertake tasks requiring long-continued, close visual application. Today, most of this close eye work is carried on indoors, where the illumination which has usually been provided does not approach that to which eyes became accustomed in past centuries. The process of becoming civilized or of becoming educated, therefore, is responsible for placing a very unnatural burden upon the eyes of mankind in general and upon the eyes of school children.

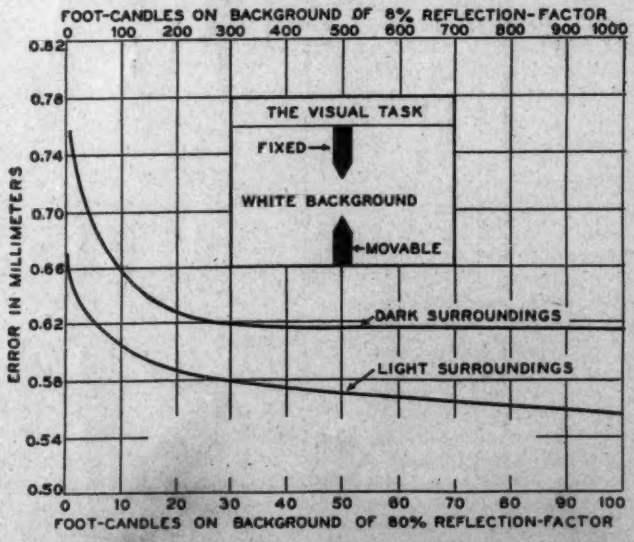


Fig. 7. Showing the effect of level of illumination upon the precision of performing a mechanical task guided by vision. The insert illustrates the visual task. The term "dark surroundings" means that the visual field, except for the small portion shown by the insert, was comparatively dark. "Light surroundings" means that the entire visual field was approximately the same brightness as the field immediately about the test-object. (Fig. 5.)

No matter to what length we go to improve the visibility and the comfort of seeing schoolroom tasks, as long as the eyes of the child are chained to work held less than arms' length away or as long as they are chained to the discernment of critical detail for prolonged periods at any distance, there will be an unnatural burden upon the eyes of the students. Today when there remains so much to be done to achieve optimum visibilities and seeing conditions for classroom tasks (and in the work-world) we are developing into a nation of visual cripples. Reference to the percentage of our young men who are unable to qualify for the air forces because of deficiencies in vision emphasizes this point. It is further borne out by the fact that while most children enter school with so-called normal vision, 22 per cent of those who graduate from high school are afflicted with some form of eye defectiveness while 40 per cent of those who graduate from college are so handicapped.[22] It has been truly said that eyeglasses are the badge of civilization — of an educated society.

In considering the degree of visibility to provide for a given eye task in the schoolhouse, account must be taken of the ability of the individual eyes subjected to that task. Some of these eyes register much more perfect visual impressions than others. As a matter of fact, in a regular classroom eyes might range from those possessing so-called normal vision to those with a degree of defectiveness which is just above the point below which the student possessing them would be admitted to a sightsaving classroom. Also, some eyes are more sensitive to disturbing brightness ratios in the visual field and to other defects in the environmental seeing condition. Eyes which are more sensitive may or may not have the attribute which would cause them to be classed as "normal."

Eyeglasses

Eyeglasses are probably the most accepted aid for improving the visual effectiveness of those who are handicapped by eye defects. But even this aid is not utilized in the school as it should be. Much more attention is devoted to dental hygiene than to eye hygiene in the average educational program. In many school systems the children are taught the proper care of teeth, and in some regular dental care is a part of the program. In few, if any schools, are the children given regular eye examinations, and in none is there any training on the proper use and care of the eyes.

There are many school children who should be wearing eyeglasses today who do not have them, and neither they nor their teachers nor their parents may know that they need them. There are many other students who have eyeglasses which are no longer suited to correct the defects to which the wearers are subjected. And there are many others who have proper eyeglasses who do not wear them when they should.

The characteristics of what and how the child sees in the classroom are fairly well fixed. While for some of the visually handicapped children improvements in seeing conditions can be made to reduce the correction required, for the vast majority of cases a given optical prescription will help the students to see better or more comfortably, irrespective of the status of seeing conditions otherwise. Hence, the provision of an adequate eye health service, including eye wear for those who need it, also becomes a primary consideration of those who are concerned with improving seeing conditions in the school.

(To be continued)

[1] In one case, an office building was relighted raising the illumination from about 10 foot-candles to 50 foot-candles. Not long after the relighting was completed, one of the building occupants complained that his new fluorescent lighting was producing "too much light," or the light from the lamps was hurting his eyes or something. The complaint was studied by an illuminating engineer from the viewpoint of the individual seated at the desk. It was found that the brightness ratio between the white paper used and the black desk top was very high and quite disturbing. Substituting a light (35 per cent reflection factor) linoleum for the black (7 per cent reflection factor) linoleum entirely eliminated all objections from this individual. Not long after, there was a similar case in the building and the same solution was equally effective.

Plans for Setting Up Vocational and Industrial-Arts Courses

*Floyd R. Love**

In the new K–6–4–4 plan of education, as adopted in Stockton, Calif., the industrial-arts courses will be given a chance to function as an integral part of general education. Good industrial-arts courses have a real contribution to make to general education if given the opportunity. We are living in a mechanized world and it is the duty of our school to show our children what this world contributes toward our present living standards. This cannot be done simply by reading about it. Participation in some activity that is a part of this world-wide mechanization will help to inform and impress the student with its importance.

A well-rounded industrial-arts course also functions in vocational guidance. Students interested in activities requiring both hand and mind co-ordination are given a chance to express themselves in a practical manner. The courses must have thought stimulating content as well as physical activities in them if they are to serve a real guidance need. Students wanting to enter industrial fields should be acquainted with the necessity of the why, as well as the how of a job. Learning to do by doing means also learning to think while doing. To permit a student to let down in his thinking while in an industrial-arts shop is not giving him a square deal. He should be given a chance to think his way through the new experiences he is having. This procedure not only contributes toward setting up constructive thinking, but has real values in guidance because it gives a truer picture of the requirements necessary for entering practical fields of work.

Shop courses, if they are to function properly, must not have enrollments of over 24 students. All instruction is individual; hence, personal contacts are necessary. The average class period is 55 minutes in length, and when starting and stopping time is taken from it, you have about two minutes a day per student for individual contacts. Courses have to be administered to meet individual needs because of such a variety of abilities found in a class. Some general information can be given to a class, but progress in constructing projects can never be run on a class basis. When this is attempted, it reduces the desire to work to capacity for some students, and discourages the slow ones by prolonging the time required to do a job. Students should be stimulated so as to grow in job pride by individual accomplishments. Comparisons must be made at times to stimulate this prized possession of job pride. A teacher can stimulate job pride oftentimes by having a personal project under construction in the shop that displays neat, accurate work.

An industrial-arts shop, well organized, can contribute toward establishing some very desirable work and social habits. These habits can only be acquired, however, when class enrollments do not exceed the maximum. One of the main objectives in a school shop should be the forming of proper work habits. Students should learn from the start that a shop is a place to learn to work in, not a place for play. Work habits can only be acquired by the proper use of time. The value of time can easily be shown in its relationship to specific jobs. Pressure has to be exerted at times on students if time values are to be established. Care has to be taken, however, to see that job pride is not sacrificed for time value.

To succeed in an industrial-arts shop a student has to learn to work with others. He needs to learn how to share the uses of the different hand and machine tools as well as shop supplies. He should be encouraged at times to help other students who need it, providing he has the necessary skills and information to be of help. He also learns how to take orders from the teacher and execute them according to prearranged plans. One of the big factors in determining the grade earned in a school shop should be the ability of the student to work with others.

Industrial-arts courses should be organized to stimulate thinking and to help put into practical use subject matter acquired in the regular academic courses. Mathematics and elementary science can easily be correlated and made very interesting through shop activities. In seventh- and eighth-grade shopwork geography, history, reading, and spelling can also be correlated to some extent with practical shop activities. It cannot all be done in the shop. The regular grammar-school teacher needs to work with the shop teacher and carry some shop problems into her classroom for consideration.

All industrial-arts courses, to function properly, must be organized as integral

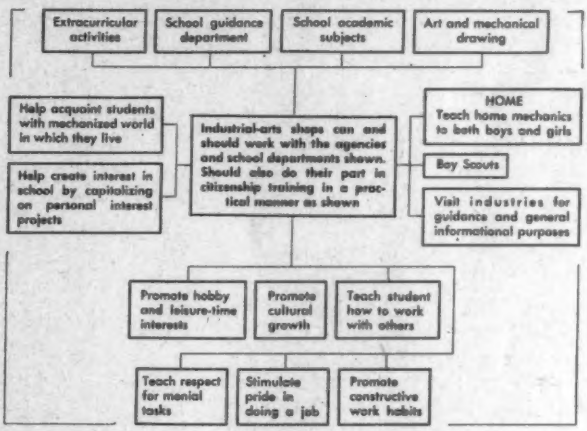

Extracurricular activities
School guidance department
School academic subjects
Art and mechanical drawing
Help acquaint students with mechanized world in which they live
Help create interest in school by capitalizing on personal interest projects
Industrial-arts shops can and should work with the agencies and school departments shown. Should also do their part in citizenship training in a practical manner as shown
HOME
Teach home mechanics to both boys and girls
Boy Scouts
Visit industries for guidance and general informational purposes
Promote hobby and leisure-time interests
Promote cultural growth
Teach student how to work with others
Teach respect for menial tasks
Stimulate pride in doing a job
Promote constructive work habits

Fig. 2

*Director, Vocational Education, Stockton, Calif.

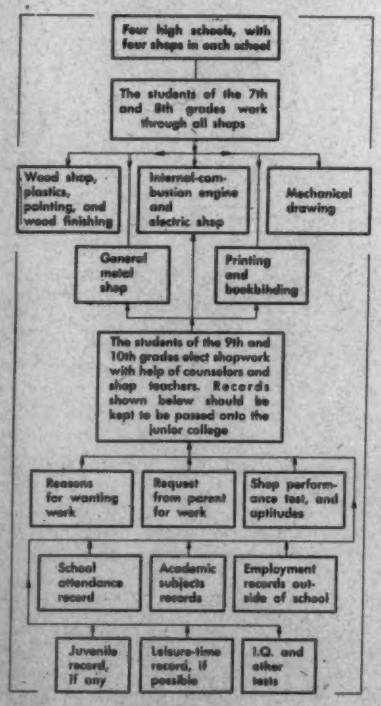

Four high schools, with four shops in each school
The students of the 7th and 8th grades work through all shops
Wood shop, plastics, painting, and wood finishing
Internal-combustion engine and electric shop
Mechanical drawing
General metal shop
Printing and bookbinding
The students of the 9th and 10th grades elect shopwork with help of counselors and shop teachers. Records shown below should be kept to be passed onto the junior college
Reasons for wanting work
Request from parent for work
Shop performance test, and aptitudes
School attendance record
Academic subjects records
Employment records outside of school
Juvenile record, if any
Leisure-time record, if possible
I.Q. and other tests

Fig. 1

parts of general education. They must be open to all students and made flexible to meet individual needs. Skills are incidental to constructive thinking. Care should be exercised to keep all activities within a boy's world. All projects, as far as possible, should have personal interest. Supplemental information having general practical and cultural values should parallel all shop activities and projects. Interests that have an avocational carry-over into later life should be stimulated. Shop progress cannot be measured simply by projects produced, but rather by results involving attitudes, interests, and growth in putting into practical use a combination of general information.

Vocational Courses

Vocational-shop courses must be specific in nature and organized to meet a definite need. This cannot be done by a school department acting independently of the crafts concerned, but must be set up by a committee representing all agencies which are affected by the training courses. Public schools have, in the past, been too willing to set up courses independently of the community in which they are placed. If a school system is to serve a community, the community must be given a chance to cooperate with it. If this is done, a community school consciousness is bound to develop that will aid in helping to set up a real functioning school system. Community co-operation does not mean dictation. It means finding out what a community needs and then setting up a plan to meet those needs.

Trade advisory committees representing labor, management, and education have been functioning in Stockton for over 20 years. At no time during these years has any dictating been done to the school superintendent or to the board of education. Labor and management have always shown a fine co-operative spirit and donated hours of time to develop real, practical, functioning courses. One of the greatest contributions a committee of this kind can make is in setting up the length of a training period, and in determining a workable course of study for that period.

A school department working independently of such a committee, does not have sufficient background or experience to make valid decisions about training periods or courses of study. Decisions of this nature must come from people with years of experience. At no time have we found a committee in Stockton that wanted to rush a boy through his course or shorten the length of a training program. The committee members all want courses set up on a four-year basis, but elastic enough to meet the educational and financial needs of the individual. They would rather have a boy stay in a course the full length of the training period, but they also feel that if he cannot, the courses should be organized to render maximum service for the time the student can devote to them.

When students graduate or leave the vocational courses before graduation, the committees help in placing them in their apprenticeships. After placement they supervise the training until the apprentice period is completed and a certificate of graduation has been issued. Time allotted for school training is also worked out by the trade committee. This varies with the length of apprenticeship demanded by the different trade crafts.

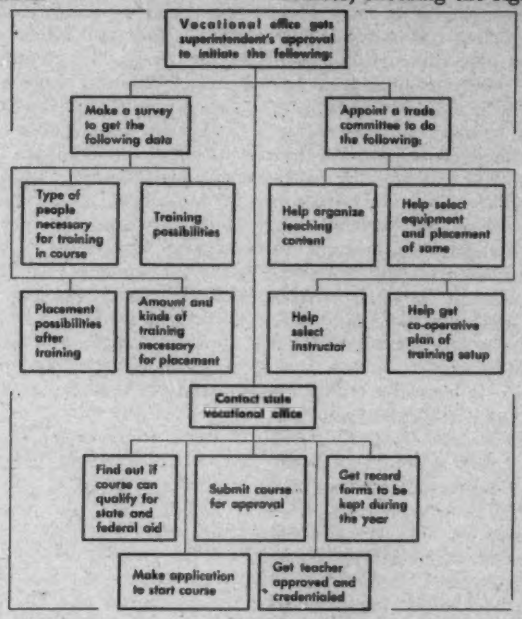

Vocational office gets superintendent's approval to initiate the following:
Make a survey to get the following data
Appoint a trade committee to do the following:
Type of people necessary for training in course
Training possibilities
Help organize teaching content
Help select equipment and placement of some
Placement possibilities after training
Amount and kinds of training necessary for placement
Help select instructor
Help get co-operative plan of training setup
Contact state vocational office
Find out if course can qualify for state and federal aid
Submit course for approval
Get record forms to be kept during the year
Make application to start course
Get teacher approved and credentialed

Fig. 3

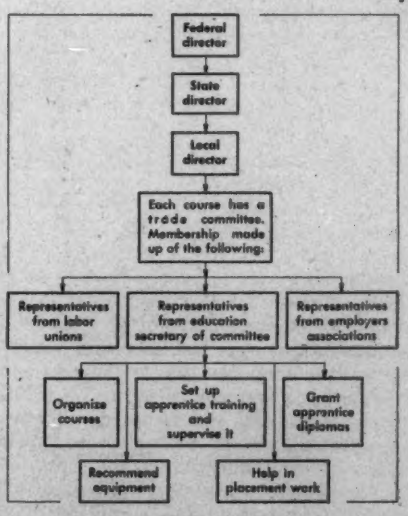

Federal director
State director
Local director
Each course has a trade committee. Membership made up of the following:
Representatives from labor unions
Representatives from education secretary of committee
Representatives from employers associations
Organize courses
Set up apprentice training and supervise it
Grant apprentice diplomas
Recommend equipment
Help in placement work

Fig. 4

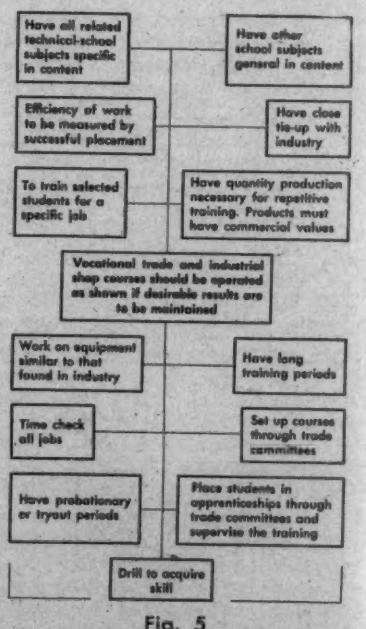

Have all related technical-school subjects specific in content
Have other school subjects general in content
Efficiency of work to be measured by successful placement
Have close tie-up with industry
To train selected students for a specific job
Have quantity production necessary for repetitive training. Products must have commercial values
Vocational trade and industrial shop courses should be operated as shown if desirable results are to be maintained
Work on equipment similar to that found in industry
Have long training periods
Time check all jobs
Set up courses through trade committees
Have probationary or tryout periods
Place students in apprenticeships through trade committees and supervise the training
Drill to acquire skill

Fig. 5

All committees are acquainted with the federal Smith-Hughes and George-Dean Acts and know how they work to promote organized training for all skilled crafts. Courses are organized on a basis of three hours of shopwork, and one hour of related technical instruction per day to meet federal and state requirements. Some of the most efficient courses are organized so the shop instructor teaches all the related subject matter but English and history. This plan is the most efficient, if the teacher is properly credentialed, for it makes correlation of all subjects easier and more effective. No one knows as well as the shop teacher the shop mathematics, science, drawing, safety, and hygiene connected with his trade.

Before new trade courses are started, trade committees are formed. In this way proper relationships are set up, not only for placement purposes, but for outlining courses, choosing the right kinds of equipment and teaching force to carry on the training. When this procedure is followed, very little difficulty ever develops later to retard or create discord in carrying on the work. The most common criticism brought to the school department's attention by our trade committees is the methods of guidance used to recruit students for vocational programs.

The vocational teachers all feel most definitely that more thought and planning should be done in the future toward constructive guidance. All vocational courses are specific in nature and only students who can profit from this particular kind of training should be guided into them. Too often in the past a student's I.Q. rating has been the only determining factor relative to whether he should enter a vocational course. This shows a definite lack on the part of our guidance people in knowing who and what kind of people operate and manage American industries. Industry needs people with average intelligence just as do the professions. There is more chance for advancement in industry for intelligent people, who are willing to work, than in a great many of the so-called professional fields. If industry were to be manned by the kind of people some school folks think should be in it, the chances of winning World War II would have been next to nil. Industry can absorb many levels of intelligence, but cannot become overmanned by workers who cannot think for themselves. Tradesmen do not want workers in their crafts who cannot do their own thinking. Trade standards and trade progress can never be any greater than the average intelligence of the group in that trade. All crafts are interested in lifting their standards and realize that this can only be done by raising the average intelligence of their different groups.

As shown in the diagram in Figure 1, a student should enter the junior college in his eleventh year with a definite record of performances from his high-school work. This record should be inclusive enough to help both the guidance office and the vocational teacher in placing the student where he can accomplish the most. If he does not have those records, then some kind of a definite program should be set up that will help obtain them. This procedure cannot be overemphasized, for at present, it is the bottleneck in helping to place people in our public-school systems where they can be of the greatest service to themselves and contribute their maximum service to society. It would be a wise procedure for guidance people to meet with trade committees once in a while and find out in a practical manner what prerequisites are necessary for particular types of work. Our schools need more practical guidance and help, through this medium,

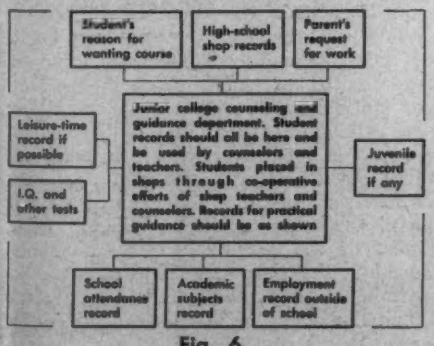

Student's reason for wanting course
High-school shop records of
Parent's request for work
Junior college counseling and guidance department. Student records should all be here and be used by counselors and teachers. Students placed in shops through co-operative efforts of shop teachers and counselors. Records for practical guidance should be as shown
Leisure-time record if possible
I.Q. and other tests
Juvenile record if any
School attendance record
Academic subjects record
Employment record outside of school

Fig. 6

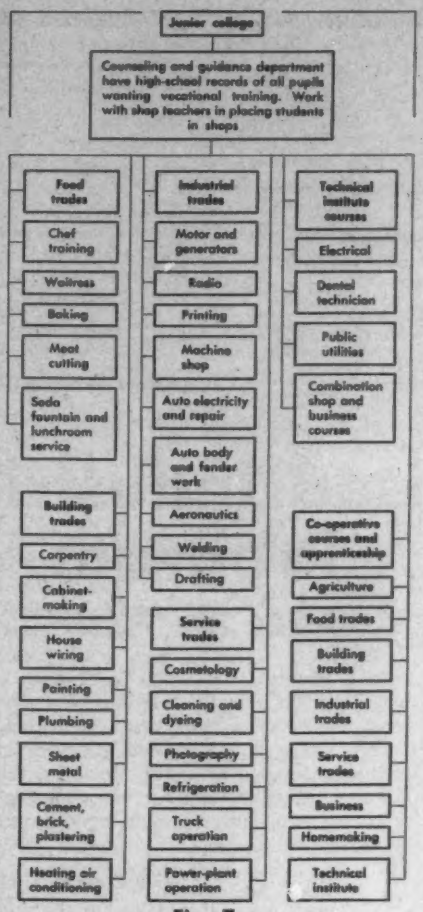


Fig. 7

should be set aside for home contacts and guidance personnel *forced* to assume the responsibilities of making periodic home contacts. These contacts will necessarily vary according to individual needs.

Too much has been said in the past about the lack of cultural values in many of our vocational courses. The right kind of teacher contacts is just as important in a vocational course as in any other. Cultural training is not so much the result of subject matter contacts as it is teacher contacts. Student association with the right kind of a teacher has definite cultural values regardless of the subject matter being presented.

A vocational course has many different avenues through which to work, to promote cultural training. The values of these avenues will, however, be determined by the definition given the word culture. Too often in the past, culture has meant ability to absorb academic information rather than an ability to perform properly as a self-respecting, self-sustaining citizen. Learning how to work harmoniously with other people, as a student in a vocational course must do if he is to remain in the course, has definite cultural values. Appreciation of time values and respect for equipment and being honest about the supplies he uses, also makes a certain contribution. Taking direction from a teacher gracefully about how to do a piece of work properly, and acquiring dignity and job pride by doing it that way, must have definite cultural values. Making material things to be used and enjoyed by others, rather than just for himself, helps a stu-

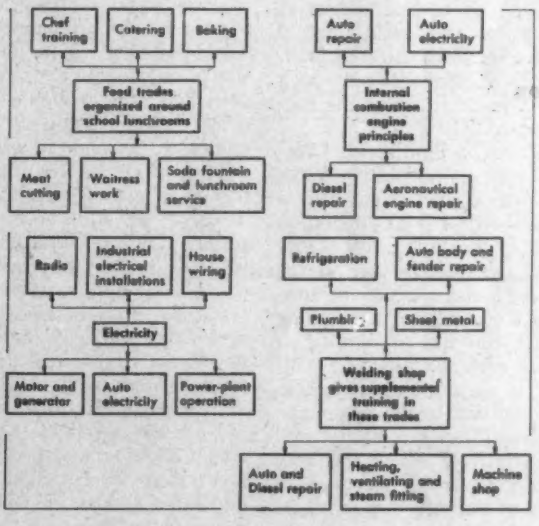


Fig. 8

in saving years of time for many of its students. Guidance, to be effective, needs student-home contacts as well as occupational information. Homes should be encouraged to work with the schools on this problem if it is to be efficiently solved. The initiative on this co-operative effort will have to come from the schools. Time

dent to learn and appreciate his work in a cultural way. Other values as well as these could be cited. Culture can be defined, I believe, very simply, as ability to do the right thing at the right time. A vocational course properly organized, supervised, and staffed can contribute its share toward developing this concept of culture.

COURSES THAT NEED ELEMENTARY TRAINING IN SEVERAL CRAFT SKILLS

Course	*Additional Subjects Needed*
Ventilating and air conditioning	Sheet metal, electrical, plumbing.
Heating and steam fitting	Sheet metal, electrical, plumbing.
Meat cutting	Elementary cooking in meats and salesmanship.
Cleaning and dyeing	Elementary tailoring and altering.
Tailoring and altering	Elementary cleaning and dyeing.
Drafting	Machine shop, patternmaking, foundry.
Auto body and fender repair	Sheet metal, welding, painting, auto repair.

COURSES REQUIRING SHORT UNIT PREREQUISITES

Course	*Short Unit Course Required*
Auto electricity	Auto repair and elementary principles of electricity.
Diesel repair	Auto repair and elementary principles of electricity.
Aircraft engine repair	Principles of internal combustion engine and electricity.
Radio	Principles of electricity.
Motor and generator	Principles of electricity.
Power-plant operation	Principles of electricity.
House wiring	Principles of electricity.
Truck operating	Principles of internal combustion engine, and trouble shooting in auto shop.
Auto repair	Principles of internal combustion engine, and electricity.

A Revised Industrial-Arts Program

*Frank W. Trella**

A new industrial-arts program for Smithfield high school, Smithfield, Ohio, seems desirable in the light of changing times. This means not only new plans plus added equipment, but equally important, newly defined functions and purposes of a shop program integrated with the purposes of the school as a whole to meet the future needs of youth in and around the small village served by the school. In order to more fully appreciate the need for a better shop program, it is necessary first to present a résumé of the environmental conditions of the community together with some of the relative factors that play such an important part in determining the success of the program.

The small village of Smithfield, Ohio, with a population of approximately 1200, has a school district extending over a radius of six miles with a total population of about 3000. It is geographically located 15 miles west of the Ohio River, on the banks of which are found some of the largest steel mills in the country. Surrounding the town are many of the larger bituminous coal veins in eastern Ohio. The coal-mining industry is the most prominent in the vicinity. In addition to the mines and mills, the outlying district is fairly well represented by relatively small tracts of farmland. In general, therefore, most of the student body of Smithfield high school is made up of sons and daughters of workers employed in these major industries.

The present school, which was opened in 1927, has an average enrollment of 450 students, including both junior and senior high school. It is apparent that during its construction the need for a more expansive shop program was not contemplated for the result was the building of a one-room hand-woodworking shop which would hardly suffice for a toolroom of even the medium-size shop of today. However, this situation prevailed until a few years ago when it became necessary to build a new and larger shop.

The Present Shop

The most practical location for the shop was the basement of the neighboring elementary-school building having dimensions shown in the accompanying illustration. The original plans for the training within the physical limits of the space provided then and still available did not embrace many of the features which now seem advisable. Though it was intended for a general shop, the resulting activities were mainly woodworking with perhaps mechanical drawing and some practical work in auto mechanics. The study of auto mechanics met with the least success because space and equipment limitations permitted only a rudimentary program. Subsequently, no significant demand for renewed activity in this area has developed which would justify further consideration at this particular time.

Near the center of the main laboratory, which should have been the most active area, there was originally a photographic darkroom and an office for the instructor. Because the darkroom was never equipped and used as such, it was later changed into a toolroom. By extending these rooms and occupying this potentially valuable space, it was necessary to crowd all the woodworking machinery in the right front section of the shop. Such inadequate spacing of these machines naturally presented a dangerous and inefficient method of carrying out a shop program.

The drawing room, represented by the same area in the revised plan, was poorly equipped. The drawing desks were used, at one time, in the classroom of the elementary grades and were arranged with disregard to natural lighting. Other than a small cabinet for the drawing equipment, no other facilities were present. Between the drawing room and the main laboratory no provisions were made to exclude the dust and noise that was prevalent. With such arrangement of equipment and other facilities the program was naturally limited in its scope.

This constituted the industrial-arts program for Smithfield high school up to 1942, at which time the shop was closed due to the loss of the instructor to the armed forces. During this intermission, the writer who is familiar with the situation, has been given the privilege of proposing a revised program which would give this school a more purposeful and more effective beginning in this department in the postwar future.

The first and natural question encountered at this time is, what constitutes a good industrial-arts program for Smithfield high school? Bearing in mind the social, economic, and environmental factors presented, what kind of a program would best meet the future needs of youth of this community? These factors can be expected to have some bearing on the kind of industrial-arts program that would be projected and carried out. The problem at present is not primarily of a financial nature, but it is rather a matter of organizing a new shop program and in integrating it with the other curriculum offered, using most of the material already available, making the necessary physical changes within the shop, and purchasing only the limited amount of machinery and equipment that is urgently needed in the begin-

*Formerly instructor at Walbridge High School, Walbridge, Ohio, and later with the armed forces of the United States.

ning. It is intended that other facilities would be added periodically according to the relative financial status of the school.

Suggested Rearrangement of Present Shop

In answer to the need for a physical reconstruction of the program, the writer has proposed the revised floor plan shown. This plan includes the following changes: (1) removal of the toolroom and instructor's office which formerly occupied the center of the main laboratory activity, (2) construction of a partition between the finishing room and the stock room, which under the old plan was intended for the study of auto mechanics, (3) installation of a partition and door (upper sections of which should be glass) between the main laboratory and the drawing room, (4) addition of a few essential metalworking machines, (5) construction of combination drawing-and-writing bench-type desks for the drawing room, and (6) building or purchase of such minor facilities as the tool cabinet, finishing cabinet and bench, scrap-wood rack, clothes rack, and the addition of a few workbenches.

Among other desirable changes, a new wiring and lighting system would naturally be necessary by virtue of the changes in the location and addition of machinery and facilities. To make the shop more inviting, a coating of light paint also was recommended. Since all other basic necessities are available, the foregoing recommendations indicate the extent of the minimum physical changes required in the revised general shop for Smithfield.

In contrast to the former layout, these physical changes offer many distinct advantages. By adequately and systematically spacing the machinery the possibility of accidents has been minimized. The shop is arranged so the instructor may observe students at work from almost any position. Sufficient space has been provided for further addition of machinery or equipment.

The combination tool and stock room in the location proposed in the new plan, has several advantages in itself. Not only would this release a considerable amount of floor space, as compared to the former location, but it would be accessible enough for all shop purposes. In addition, the issuing of tools and stock and the maintenance of records could be handled efficiently by only one student.

The present physical layout allows more than sufficient space necessary for the finishing room. A portion of this area could be withdrawn later with the least amount of difficulty and utilized advantageously for an additional small shop area should the need arise.

The same location for the drawing room as before is no doubt the most appropriate. In addition, it should be partitioned from the main laboratory to provide freedom from dust and to reduce the noise that the former arrangement made inevitable. For economy and practicability combination drawing-and-writing desks are proposed. Sufficient desks could be built to accommodate even the largest class. Suggested for the rear of the drawing room is a simply designed bookcase to house books and reference material and a cabinet for drawing equipment. The installation of fluorescent lighting to add to the economy and efficiency of this area should be given careful consideration. This concludes the major physical changes in the shop layout.

Considering the size of the school and the nature of the environmental factors, the aim of the general shop program would naturally be that of general education. Variations within the program to meet certain specific needs could be developed accordingly.

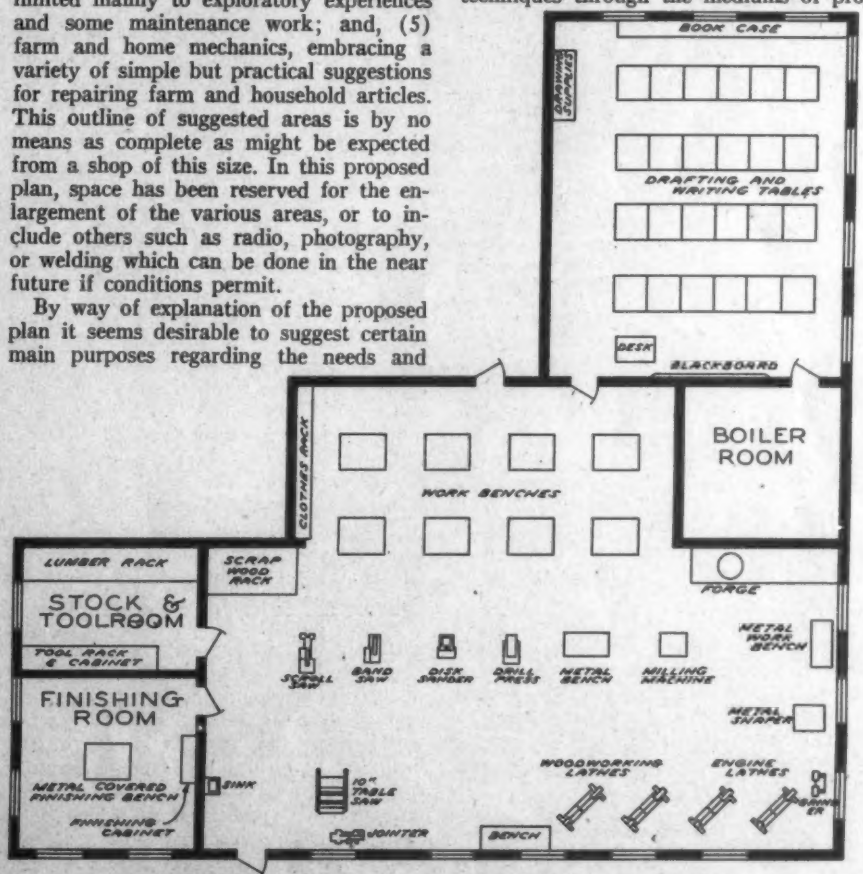
Suggested Curriculum

As a result of a comparative study of the former shop arrangement and all possible predetermined factors affecting the limitations of a shop program for this school, the writer suggests these particular areas for the new program: (1) general woodworking, including cabinetmaking and fundamentals of carpentry; (2) metalworking, comprising basic machine-shop practice and art-metal and sheet-metal work; (3) mechanical drawing, with particular emphasis on planning and drawing current shop projects; (4) hand forging, limited mainly to exploratory experiences and some maintenance work; and, (5) farm and home mechanics, embracing a variety of simple but practical suggestions for repairing farm and household articles. This outline of suggested areas is by no means as complete as might be expected from a shop of this size. In this proposed plan, space has been reserved for the enlargement of the various areas, or to include others such as radio, photography, or welding which can be done in the near future if conditions permit.

By way of explanation of the proposed plan it seems desirable to suggest certain main purposes regarding the needs and demands of the students which gave rise to it. The puposes of this general shop are not different from those already well established and highly advocated by educators in the past. They merely vary in the degree to which they can be achieved according to the relative local situation. More specifically, however, this proposed program should include such functions as orientation, particularly in the junior high school; a development of fundamental skills and techniques; a study of appreciation and consumer education; and a fairly comprehensive program of guidance.

Perhaps the most fundamental of all purposes in such a program is that of orientation. It may be true that the areas represented in this shop plan are far from adequate for purpose of orientation. However, it is not always the amount of physical or tangible properties at hand that determine the extent or possibilities of a good shop program. Theoretically speaking, other features could be represented to a certain extent, by other methods such as lectures, discussions, students' reports, field trips, and films. Even though the use of these devices has been advocated in the past, they have not always been practiced to the fullest extent. In a school, limited in its resources and facilities as this, it is important that they be included in order that the students may gain the maximum benefits of the program.

Development of fundamental skills and techniques through the mediums of proj-



Smithfield Village School, Smithfield, Ohio — general shop

ects is a natural purpose of all shop programs. However, more emphasis should be placed upon the type and quality, rather than on the quantity aspects of the projects. Projects should be chosen to meet certain needs and specifications of construction. This would tend to eliminate unnecessary waste of material and time as a result of poor construction or obsolescence.

Consumer education, appreciation, and evaluation of products is becoming increasingly important in modern social living. To be able to purchase intelligently is a contribution in itself. In order to fulfill this need it is suggested that such a study be included in this program since there is probably no more appropriate place to develop it so effectively as in the shop. This might embrace a study of past and present designs, customs, and styles, a comparison of hand- and machine-made products, and self-evaluation of students' own projects.

Since so little has ever been developed in line with leisure-time hobbies and interests in this school, its sponsorship would seem justifiable in this program. These activities could be promoted concurrently with regular shopwork or carried on outside of classroom under the shop administration. These could be developed not only for amusement or recreational purposes, but also added to the students' fund of skills and techniques that would aid them in the future.

Vocational Guidance

No shop program could be complete without some form of guidance activity, particularly with reference to the vocational aspect of the individuals concerned. A study of orientation, the building of projects, and other functions are very important, as has been stated before. But without some form of vocational and educational guidance program co-ordinated with the other departments of the entire school, such activities would fall short of their objectives. In this respect, the revised program should include some study of occupational information, abundance of related vocational literature, special attention to handicapped individuals, effective work-and-study schedules, employment recommendations, and follow-up work. In addition, such supplementary aids as speeches by professional men, employer representatives, journeymen in skilled crafts, and research reports by students themselves would certainly be credible.

Special attention should be employed in connection with individuals who are physically or mentally handicapped. Special projects in line with their relative physical or mental capabilities would not necessarily make it inconvenient to carry on regular shopwork since the number of such cases would never be large.

The Co-operative Program

Perhaps, at no other time in the history of the schools has it become so evident that the schools could play such an important role in an emergency by means of work-and-study schedules. This has caused a bit more difficulty, on the part of the school administrators, in changing schedules for students to carry on their schoolwork, but it also noticeably aided to meet the demands of production on the outside. There is no doubt that this practice will continue even after the war is over, as already expressed by administrators today. However, the emphasis should not be that of production alone, but rather on the maximum educational values derived in terms of skills, techniques, and knowledge gained from work experiences and applied toward the individual's future need and use. In general, those individuals engaged in part-time employment co-operatively arranged by the school and the employer should find it a worthy endeavor. In such a small school as this, care must be administered in making selections in order that the progress of the educational program is not impeded.

Employment trends and possibilities should always be a part of the entire school program irregardless of the fact that this is not a vocational school. It is only natural that effective job placements would be limited accordingly. However, recommendations by the school should always be initiated with due respect to the quality and potentiality of the individual who finds it necessary to seek employment after leaving school.

Follow-up work is an essential instrument in any guidance program and should not be omitted here. Important data on students graduating each year should be kept up systematically as a matter of permanent record. Such records should prove invaluable as a basis for determining certain changes needed in the school program to benefit the coming students.

A recent survey of male students of Smithfield high school between the years 1935—41 revealed that over 50 per cent worked in the mines, 20 per cent were employed in the transportation industry, 10 per cent were engaged in farm work, 5 per cent found employment in the sales and kindred occupations, 5 per cent entered college or other institutions of higher learning, and 5 per cent were engaged in miscellaneous work. The extremes in this survey, therefore, would indicate a necessity for some form of guidance work. The fact that the mining industry is very essential has undoubtedly been proved during the war emergency. It is also true that this industry is the most accessible, a factor which cannot be overlooked. However, this factor does not necessarily justify the employment of so large a percentage of boys in this industry, particularly when the work is largely of the unskilled type, and the average earnings over a period of time have never exceeded normal living conditions. As a matter of fact, this large percentage of boys did not *choose* mining as their occupation. Because of a lack of some form of guidance, and because of unpleasant economic and environmental conditions, they simply accepted mining as their only escape. These same factors hold true in explaining the low percentage of students who took up further schooling. Such instances merely show the need for more active participation in a guidance program which would bring about a closer correlation to enhance the objectives of this proposed plan.

The proposed new program, however, is not looked upon as a solution to the entire problem. It is merely a tentative method of creating a good sound basis for developing a more complete and more flexible industrial-arts program to which could be added other areas and more effective applications of practices and methods. It is a real challenge to the coming instructor and it is hoped that the progress of the shop will help him obtain additional equipment and facilities so that the work can be made truly effective and helpful.

PREPARATION FOR LIVING

SOPHIA ANNEBERG CUMMING

Jacksonville, Fla.

The youth who aspires and is willing to learn;
And the worth-while things to achieve and to earn,
Opportunities abound for him as never before,
Which availed not his forebears in the days of yore.

The arts and the crafts, and through training the hand,
Are treasures of knowledge for him to command.
He strives, by right thinking and labor and skill,
To achieve a high goal with a purpose and a will.

Provided with materials and the tools of a trade,
He learns to make adjustments to changes ever made.
As he gains skill and trust he has nothing to fear,
But contributes to his growth and a future career.
This eagerness of youth with his ever-growing powers,
In these swift-moving times, and this changing world of ours,
Requires zest and zeal to keep up the pace
And to tackle the problems he surely must face.

If interest and pride in his daily task he shows,
Time will bring reward, for he reaps the fruit he sows,
He learns *how to live*, and prepares to be a man.
By raising his standards, and doing the best he can.

An Industrial-Arts Expansion Program

*G. Wesley Ketcham**

Preliminary surveys into the industrial needs and the educational facilities in the City of Norwalk, Conn., during the year 1941 revealed a definite need for an expansion of the shop and industrial training courses offered in the school system. A suggested program for the city at this time failed to receive financial assistance and the proposed expansion was temporarily delayed.

As a later need for preinduction courses developed, a more serious consideration of the problem was made and in February of 1943 plans were organized for the introduction of a state bill to finance the expansion of the technical and vocational training in Norwalk.

The Program Before Making The Changes

In general, the following is a picture of the offering in this field prior to the introduction of the expansion program:

In the senior high school, with a registration of approximately 1400 students, the industrial-arts facilities consisted of one general shop and a biology room which was also used for mechanical drawing. The offerings in the general shop were as follows: general woodworking (tool and machine operation); general metalwork (bench, machine, sheet metal, foundry, and forge); general electricity (theory, circuits, testing and service); general service and maintenance (repair and service including theory of automotives). The foregoing represents the basic area divisions of shop activity. Enrollment — 25 pupils, 6 periods; total daily enrollment — 150 pupils.

The laboratory tables in the biology room served as drawing benches for the mechanical-drawing classes. This situation was hardly ideal, but it did serve to provide additional working space for pupils desiring more industrial information. The first year mechanical drawing was taught on a part-time basis by a regular teacher of mathematics. The regular general-shop instructor taught the advanced course in mechanical drawing in the same room.

There are three junior high schools in Norwalk, and the enrollment and shop facilities were approximately as follows:

Benjamin Franklin Junior High School. Approximately 320 boys, 336 girls. Total enrollment, 656.

Shopwork consisted of woodworking, reed work, and some mechanical drawing offered by one full-time instructor and one part-time instructor. This work was offered in one large room divided by a partition.

The equipment in these shops was very poor, for example: The hand-tool valuation for both shops would hardly exceed $40.

Center Junior High School. Approximately 276 boys, 284 girls. Total enrollment, 560.

Shopwork was taught in two shops located in an adjacent building. Both offered a large amount of woodworking with one shop doing some metalwork and electricity. The other offered a limited amount of printing, largely of a production nature. On the second floor of the same building a room was set up to offer mechanical drawing. The room capacity is 32 students. Drawing was taught by the two shop teachers.

Roger Ludlow Junior High School. Approximately 131 boys, 155 girls. Total enrollment, 286.

The shopwork consisted mainly of woodworking and a small amount of metalwork, electricity, and drawing. The equipment was limited, in general, to the woodworking field. This work was taught by a part-time instructor.

Expanding the Programs

In May, 1943, a bill providing for the expansion of the program in the high schools of Norwalk was introduced in the state senate and was subsequently passed. It provided for an expansion of the program in the three junior high schools and the Norwalk senior high school. The total appropriation was $60,000 for the biennium ending June 30, 1945. The appropriation was divided as follows: for equipment, $24,000; alterations and installation, $8,000; personal services, $24,000; and supplies, $4,000.

The expansion in the senior high school was started at once in an effort to meet the immediate training and preinduction needs. The following units were offered in an effort to provide broad exploratory experiences and standards of skill development in terms of the individual's capacities.

General metal shop: Sheet-metal work including aircraft application, wrought-iron work (cold), foundry practice.

Electrical shop: Communications (telegraph, telephone, and radio), wiring installation and motor work, electrical servicing and repair.

General woodworking shop: Carpentry, cabinetmaking and repair, patternmaking, mill-room practice, finishing.

Graphic-arts shop: Composition, imposition, presswork, bindery, silk-screen work.

Transportation: Study, service, and repair of automotive, marine, and aircraft power plants; arc and oxyacetylene welding and cutting.

Machine shop: Machine-shop practice, forging.

Mechanical-drawing room: Machine drawing, sheet-metal drafting, architectural drawing, aircraft drawing, tracing, and blueprint reading.

This program requires five full-time instructors. Each unit handles two single period classes and two double period classes per day.

Fig. 1. View of the general metal and electrical shop. The picture shows the following: Along the left-hand side there is the general metal bench with a vise, drill press, and the soldering furnaces. Beyond the bench and across the far wall is the foundry area with a brick floor and large melting furnace. In the foreground the electrical repair, maintenance testing, and demonstration bench, are located, and directly in back of the electrical bench is the octagonal sheet-metal bench showing sheet-metal machines for wiring, burring, setting down, and crimping.

*State Supervisor of Industrial Education, Hartford, Conn.

Periods	Metal & Electricity	Wood	Graphic Art	Transportation & Machine Shop	Mechanical Drawing
1	23	25	23	25	35
2	23	25	23	25	35
3 & 4	23	25	23	25	35
5 & 6	23	25	23	25	35
Totals	92	100	92	100	140
Grand Total	524 Pupils Per Day				

unit for a short period of time can expect to become generally familiar with the nature of the work performed and the material handled within that unit. He may reasonably expect to develop certain handy-man skills which because of the very nature of this industrial-age would make him a better citizen as a consumer of industrial products. His ability to make minor repairs at home and to provide the necessary servicing of some types of home equipment would definitely be an asset to him.

FIG. 2

Fig. 2. Another view of the general metal and electrical shop. Along the right-hand side is shown the general metal bench with the soldering furnace, vises, and drill press. The sheet-metal and general metal area shows the slip rolls, metal benches, stake, and bar folder. Directly behind the sheet-metal bench in the center of the shop is the octagonal metal bench, holding forming, burring, wiring, setting down, and crimping machines. At the far end is the two-story framework used for the electrical area for the practice of house wiring. In front of this framework some of the aircraft wing and fuselage sections used in the study of aircraft sheet-metal work are shown. At the far end and to the right, the communications area may be seen. The shop display case and planning area are located along the left side.

The foregoing arrangement permits a flexible program well adapted to the various individual requirements.

A student taking a college-preparatory course anticipating technical or engineering work could enroll in one of the single-period classes for mechanical drawing and one of the shop courses. Course requirements would not permit such a student to take double-period work and still meet his basic college requirements.

A student preparing for a particular occupation, could major in that field and would be permitted to take shop activities in his elected field for two years on a double-period basis.

Students requiring preinduction training or a short course for a semiskilled occupation could be served in either the single-period class or a half year's course for a double period.

In an effort to bring a clear picture of the proposed industrial-arts unit and the educational possibilities a description of the physical layout and the scope of the work in each unit follows:

The degree to which skills are developed within any of these units will depend for the most part upon the amount of time spent by the student in the respective shops. A pupil taking a course in any one

FIG. 3

Fig. 3. Another view of the general metal and electrical shop. At the left is the L-shaped communication bench showing telegraph keys, earphone contacts, and oscillator used for teaching the sending and receiving of code messages. In addition the right side of the bench shows the radio section including the short-wave receiver. The 125-volt d.c. 1-kilowatt motor generator is shown in the lower foreground. The two tall panels are the supply and control board. They supply the following for testing and experimental purposes: (a) 22 volts a.c., 3-phase; (b) 110-220 volt a.c. single phase; (c) 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24 volts from a transformer; (d) 12 or 24 volts d.c. from storage batteries; (e) 125 volts d.c. from shop motor generator set; (f) charger for storage batteries; (g) field rheostat for motor generator set.

General Metal and Electrical Shop

The general metal and electrical shop is in reality two separate units or shops within one room.

The general metal section of this shop which occupies approximately one half of the available space, provides training in sheet-metal work. The shop is provided with large sheet-metal benches for layout work and the machine equipment includes squaring shear, cornice brake, a bar folder and a rotary table completely equipped with burring, wiring, turning, setting, and beading equipment. All other types of hand tools necessary to provide complete sheet-metal training are also included in the equipment list. A small foundry unit is provided in order to familiarize the student with the elements of foundry practice and the handling of molten metals.

The pupil in the sheet-metal shop for a short period of time should, at the conclusion of his course, have a general understanding of the following: (1) how to lay out, measure, cut, and fit simple sheet-metal parts; (2) how to form metal to various shapes with machine and hand tools; and (3) how to repair sheet-metal objects through the use of proper methods of riveting, soldering, and fitting. In addition to the knowledge of the general operations, the pupil should have an understanding of the care and use of the various type of tools and equipment and material used within the shop; a thorough understanding of some of the safety habits to be developed, and the occupational opportunities offered in the many related sheet-metal fields, i.e., sheet-metal aircraft work, air-conditioning work, and the general heating and ventilating fields.

The pupil desiring to study sheet-metal work for longer periods of time might well expect to develop skills in the fundamental methods used in the sheet-metal trade. His work includes simple and advanced layouts involving the use of parallel, radial, and triangulation methods for developing sheet-metal forms. He makes a comprehensive study of all types of metal used in the sheet-metal industries. In general he would

become more proficient in the various fundamental operations necessary to become a good sheet-metal worker. His knowledge would be broad enough to allow him to take his place as a beginner in any one of several sheet-metal trades.

The electrical section which occupies the other half of this shop is equipped in general as follows: (1) electrical test bench for the testing, servicing, and repair of simple electrical equipment. This bench also provides a study of home equipment including kilowatt-hour meter, fuse boxes, and main switches. (2) A motor generator set for experimental use and study of d.c. current generation. (3) A two-story framework to provide training in the fundamentals of electrical installation using bell wire, armored cable, conduit, wire molding, and typical house fixtures and switches. (4) A communications bench provides for the study of the telephone, telegraph, and the radio. (5) A control board provides a centralization of all power for testing purposes.

A pupil taking electricity for a short period of time would become familiar with some of the various phases of the electrical field. He would be trained as a wise and careful consumer of electrical power, having knowledge of the dangers resulting from poor usage of electrical equipment. He would have a general fundamental knowledge of the basic principles of electricity and would be able to make minor repairs on simple electrical equipment. The student specializing in the electrical field would have a more thorough understanding of the methods of electrical installation, including planning, estimating, and installing equipment, he would make an intensive study of current generation and distribution. Through a complete testing program involving the use of meters, motors, generators, and testing apparatus, he would become completely oriented in the basic methods used in the study of electricity. He would make a thorough study of electronics. His general electrical training would allow him to eventually specialize in one of the many occupational opportunities offered in the electrical field, such as installation, radio, television, and communications.

General Woodworking Shop

The general woodworking shop now occupies the space that was formerly used as a bicycle room, located in the basement of the East Avenue wing of the Norwalk senior high school. These two rooms are connected directly with one another and, therefore, permit a maximum of supervision by the instructor. All of the machine equipment has been placed in one of the rooms, thus making it in a sense a mill room. This allows direct supervision of all machine equipment at one time. The machine equipment includes the following: a circular saw, a jointer, a planer, a drill press equipped with mortising attachments, a grinder, four woodworking lathes, and a jig saw. Smaller machine equipment includes a bench-type drill press, a router, and a portable sander. The other room of this shop is devoted to complete hand-woodworking equipment, including bench-work and general hand-tool operations. A separate room connected to the woodworking shop provides the necessary storage space for lumber and the proper facilities for wood finishing including spraying equipment. In general, the type of work carried on in this woodworking shop consists of carpentry work including the construction of scenery, cabinetmaking and repair, patternmaking, mill-room practice, simple ship fitting, and general finishing.

A boy spending a short period of time in the general woodworking shop is given instruction in the handling and care of the various hand tools used in the carpentry and cabinetmaking trades. He learns sim-

Fig. 5. Another view of the general woodworking shop. The double woodworking benches are shown in the center of the shop. The two cabinets, along the wall to the left, hold all of the hand tools, and the assembly and gluing area is shown beyond the tool cabinets.

Fig. 4. A view of the general woodworking shop. Six double type woodworking benches are located in the center of the shop. The planning area is shown along the wall to the right. The long wall bench used for patternmaking and general handwork is shown along the fore wall. The small model house on the bench was constructed in the study of carpentry.

Fig. 6. Another view of the general woodworking shop. This room is equipped with the following machines: band saw, belt and disk sander, wood-turning lathes, jointer, and circular saw.

ple methods of measuring and laying out work, principles of construction, and methods of assembling general construction pieces and cabinetwork. He is given practice in assembling and finishing many of the various types of wood and is also given an opportunity to refinish simple cabinet pieces brought from home. In general, he gains knowledge which is of value to him in setting up his own home workshop, including instruction in simple operations on some of the various woodworking machines.

Fig. 7. View of general woodworking shop. The jig saw and floor-model drill press are shown along the fore wall. The woodworking lathe is located in front of the window. The jointer and circular saw are located in the center of the shop, and the band saw may be seen at the extreme left.

A pupil spending a longer period of time in the general woodworking shop would make a more intensive study of the various fields included within the shop. He studies layout and construction methods in the carpentry field. He learns the operation and care of the various types of power-machine equipment to be found in the shop, thus developing some general knowledge about mill-room practices and procedures. He makes a study of the many types of woods, their characteristics and common usage. Planning, estimating, laying out and construction units in carpentry, cabinetmaking, and patternmaking would form a definite part of his training program. The layout out and construction of various types of joints both by hand and by machine form an introductory basis for the development of more advanced phases of the many activities. The correct usage of paints, lacquers, shellacs, stains, and varnishes is a required part of his study of finishing-room practices. This also includes general repair and refinishing of fine cabinetwork. With the prevalent interest of many of the students in marine activities, it is quite possible that simple ship fitting and the construction of small skiffs might form a valuable part of an advanced pupil's course in general woodworking. At the conclusion of this course a student specializing in woodworking would be well equipped to take his place as an apprentice in one of the many phases of the woodworking industry. His study of proper procedure and methods, safety precautions, and general understanding of occupational opportunities make him a valuable consumer and producer in the citizenry of the future.

Graphic-Arts Shop

The graphic-arts shop is the smallest of all the shops. This unit is compact in nature and includes two printing presses (one, 12 by 18 C. & P., and one, 8 by 12 C: & P.); a 26½-in. paper cutter, one imposing table, one proof press, a bindery table, a stapling machine, a silk-screen unit, the necessary storage cabinets and files, type cabinets, and sufficient working space for 16 pupils.

Modern trends in advertising, the production of pamphlets, newspapers, and books, and the complexity of modern business through the use of its many printed forms has made the printing industry and its affiliated fields one of our leading sources of occupational opportunities.

This unit offers to the student taking printing for a short period of time an introduction to the intricacies of printing and its allied trades including elementary composition, simple lockup, presswork, simple bindery, and silk-screen methods of production. He is given a general picture of one of the largest occupational fields in our country.

The pupil majoring in the graphic-arts or general-printing studies, becomes familiar with the various kinds of type and the many methods of producing good composition. He makes a study of the uses of borders, leaders, rules, and the various forms of cuts. He becomes familiar with lockup and make-ready. He learns to take, and check proofs of the various jobs before they are run off on the press. He becomes acquainted with methods of figuring and cutting paper. Stapling and bindery work also forms a definite part of his educational program. Advertising mediums including silk-screen work form a part of his study of commercial methods of production.

The production of forms, posters, pamphlets, and cards thoroughly familiarizes him with the complexities of the modern printing establishment. Needless to say, all of the printing program is entirely concerned with school activities.

A study of the many occupational fields includes consideration of, and in many cases, visits to concerns active in commercial printing, newspaper work, periodicals, books, lithographing, gravure printing, photoengraving, bookbinding, and allied fields. A study of occupational opportunities and educational requirements gives the pupil a thorough understanding of the various fields and his shop training prepares him to enter one of them if he so desires.

Fig. 8. Transportation and machine shop. Along the wall from left to right are: (a) tool-storage cabinet; (b) Reid surface grinder equipped wth magnetic chuck; (c) planning area; (d) forge. In the center are shown the power hack saw, the shaper, and the milling machine. At the right is the large drill press equipped with automatic feed.

Transportation and Machine Shop

The transportation and machine shop is now set up in the room formerly occupied by the general shop. The fact that this

room is located at the end of the building and has an entrance which permits an automobile to be driven into the shop, is the main reason for selecting it for this type of unit.

The shop and its program is actually subdivided into three unit areas closely related to one another, namely, (1) machine-shop practice, (2) transportation, and (3) arc and oxyacetylene welding and cutting.

The machine-shop equipment includes provision for benchwork including layout and assembly. The machine equipment includes five screw-cutting lathes and attachments, two milling machines, one shaper, one surface grinder, one bench grinder, one large arbor-type drill press, one bench-type drill press, and a power hack saw.

The transportation area permits the study and care of the automobile through the use of chassis and motor stand assemblages. Facilities for studying about the use and care of outboard motors and a general study of the aircraft engine through the use of damaged or discarded mounted engine is also possible in this area. Equipment for minor repair work and servicing is included. The inclusion of a portable arc-welding outfit as well as a multiple station arc acetylene cutting and welding unit offers excellent opportunities to the pupil to become familiar with an occupation closely allied with the automotive and machine-shop industries in the field of production, maintenance, and repair of vital machinery and equipment.

The pupil taking a short course in this shop in the transportation area becomes familiar with the major parts of the internal-combustion engine, the automobile, the airplane, their lubrication problems, and the necessary precautions for their servicing and repair. In the machine area he learns simple layout work, and then goes through a series of experiences involving the use of the machine lathe, the drill press, and the miller and shaper. He is given a general picture of the machine industry and acquires certain habits and skills that permit him to do simple machine-shop work. This, of course, also includes the reading of blueprints and the use of the various measuring tools.

A pupil spending a longer period of time in this unit becomes proficient in the use of the metal lathe and its various attachments. He learns to set up work in the milling machine, the shaper, and the drill press. The production of work involving a high degree of accuracy develops an appreciation of the importance of the machine trades. General overhaul of automotive and marine engines and the use of the cutting and welding torches helps produce a type of machine worker capable of assuming a responsible position in a general automotive or machine-shop plant. Through a study of the various activities and the fields covered therein, the pupil finds an appreciation for the complexity of the modern automotive and machine shop.

The shop, in addition to the above-mentioned features, offers an excellent opportunity to present short unit courses of preinduction, or adult evening-school types of courses in such subjects as welding, automotives, or machine-lathe operation.

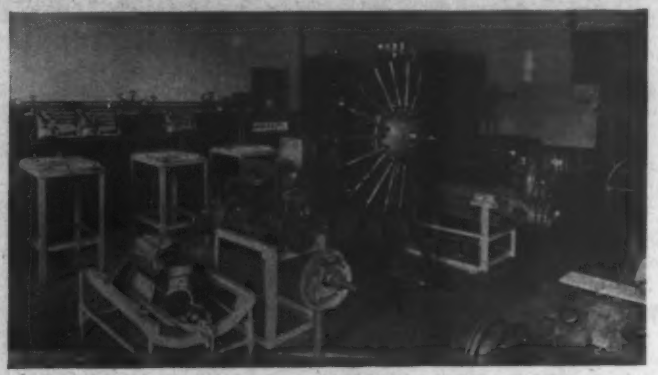


Fig. 10. Another view of the transportation and machine shop, showing the following: (a) cutaway L-head automotive engine; (b) valve-in-head automotive engine; (c) a nine-cylinder radial aircraft engine; (d) an Allison V-type aircraft engine; (e) a portable repair bench. In the foreground is a brake assembly and a cutaway differential.

Fig. 9. In this view of the transportation and machine shop are shown the following: a milling machine; a 14-in. South Bend standard gear lathe, floor type; a Logan 10-in. floor type quick-change gear lathe; a 10-in. bench-type standard gear Logan lathe; and an 11-in. quick change-gear floor-type Sheldon lathe and a 9-in. standard gear floor-type South Bend lathe. The anvil is shown to the left.

Mechanical Drawing

The mechanical-drawing room is located in the room adjacent to the proposed general metal and electrical shop. The facilities include drafting stations for 36 pupils, including drawing boards, T squares, and individual drafting tables. In addition to this major equipment, a large layout table, a cutting table, a blueprinter, and a washer is included, thus offering complete opportunity for drafting, tracing, and blueprinting.

This unit correlates all of the work in all of the other shops. Projects in wood, sheet metal, and machine shop are designed and finally blueprinted in the mechanical-drawing room. These prints then form a vital part of the programs of the various other units. Students taking the shop courses develop plans in their drafting period, directly related to the activities they are engaged in in their respective shop course.

This course allows a student to major in mechanical drawing with a view of entering the drafting field, or it gives him a background for an engineering course in college. Fundamentals of mechanical drawing include learning how to use all drafting tools and materials. It is the foundation for the development of advanced courses in the drafting field. A complete unit in sheet-metal layout work including parallel line, radial line, and triangulation methods of development is offered. Another unit is offered covering the study of machine drawing. This includes the drawing of cast and machined parts with the use of various materials showing the correct usage of threads, fits, and finishings in detail and assembly drawings.

Inking and tracing forms an integral part of all of the drafting courses and permits instruction in the use of the blueprinting machine and the washer.

Advanced study includes the consideration of cams and gears and more intricate detail and assembly drawings. Special courses in architectural drafting, electrical drafting, map and topographic drawing will be offered to those having special use

Fig. 11. Still another view of the transportation and machine shop, showing a four-torch oxyacetylene manifold system, assorted welding tips located next to each of the control valves, welding benches, Hobart motor generator arc welder and booth, a bench grinder, and some cutaway engines.

Fig. 12. A view of the graphic-arts shop, showing the silk-screen unit in front of the bulletin board, the paper stitcher at the left of this bench, the file cabinet and teacher's desk, a double-bank compositor's table, the bindery bench, the proof press and imposing table, and the paper cabinet and cutter.

for such work. A general course in blueprint reading open to all students is also offered in the mechanical-drawing department.

Such a mechanical-drawing department facilitates the offering of short, intensive unit courses in blueprint reading and mechanical drawing for evening-school applicants.

The junior-high-school expansion program was not started until September, 1944. At that time a curriculum was proposed which would offer a similar shop program in all of the junior high schools. Individual facilities and requirements were considered and finally a program offering the following basic area was suggested:

Proposed Basic Areas

Planning Area: This area should not be regarded as *mechanical drawing*, but as the title implies drafting should be included as a part of the broader field of planning.

Within this area the pupil should first learn to read simple pictorial and orthographic types of drawings directly related to the general activities of the industrial-arts shop, i.e., drawings of some of the tools and materials with which he will work as well as some of the beginning projects suggested for the different areas.

The general use of the more common tools and materials of drafting should be taught, such as pictorial and orthographic drawings of simple tools and projects.

The area should be equipped with books, charts, pamphlets, materials, etc., that will assist in the following: (*a*) the wise selection of a project from the standpoint of usefulness, design, and construction; (*b*) the changing of a drawing for design or construction purposes whenever necessary; (*c*) the listing and figuring of the quantity and the cost of materials on a uniform stock order form; (*d*) the laying out of a simple step-by-step procedure sheet to follow in the construction of the project; (*e*) the study of tools and materials related to the project and its construction.

Woodworking Area — This area should provide for experiences in the following: (*a*) cabinetwork (small projects), (*b*) concrete work (wooden forms), (*c*) carpentry, (*d*) home project construction and repair, (*e*) model building (boats — sailing and solid, and airplane, flying and solid), (*f*) plastics, (*g*) wood finishing.

Metalworking Area — This area should provide for experiences in the following: (*a*) art-metal work; (*b*) plumbing (service and repair); (*c*) ornamental ironwork; (*d*) sheet-metal work; (*e*) foundry work (a future section); (*f*) machine work (a future section).

Electrical Area — This area should provide for experiences in the following: (*a*) chemistry, (*b*) signal work, (*c*) light wiring, (*d*) magnetism, (*e*) testing and repair.

The areas mentioned in the foregoing are basic, those that follow may be included at present or should be included in future plans.

Graphic-Arts Area — (*a*) Composition, (*b*) imposition, (*c*) presswork, (*d*) linoleum-block work, (*e*) bindery, (*f*) silk screen, (*g*) photography.

Transportation Area — (*a*) Steam, (*b*) automotive, (*c*) aircraft, (*d*) marine.

Ceramics Area — (*a*) Cement (Keene cement, concrete), (*b*) glass, (*c*) rubber, (*d*) clay.

Textiles Area — (*a*) Weaving; (*b*) hooking; (*c*) knitting, braiding, tying; (*d*) basketry.

Time Allotments: Time allotments for the various grades naturally depended upon the general school program followed in each school. The following minimums were suggested as an aid to the administrators in scheduling a well-rounded exploratory course in junior-high-school industrial arts.

Seventh grade: Two periods per week for two semesters or the equivalent.

Fig. 13. In this view of the graphic-arts shop are shown the following: a paper storage cabinet; a 26½-in. paper cutter; an 8 by 12, and a 12 by 18 C. & P. printing press; a large steel top imposing table; a proof press; a small bindery unit; a 48-in. case type cabinet; and a double-bank compositor's table.

Fig. 14. The mechanical-drawing room is equipped with the following: 32 individual adjustable-top mechanical-drawing tables, and a storage and display case. Tables for the display of various materials of construction, and parts of machines and aircraft are located in the rear of the room.

Eighth grade: Three periods per week for two semesters or the equivalent.

Ninth grade: Five periods per week for two semesters or the equivalent.

Industrial Areas:

An approximate time distribution for a typical, one-teacher general shop is shown in the following table. The addition of optional areas is definitely recommended for future consideration. This would mean a redistribution of the suggested time allotments for the various areas. In general, the time allotted to each area would depend upon the nature of the area and the work experiences offered to the pupil. The wood and metal areas usually require more time than any of the others.

Where there are two or more instructors, the time allotments per area would be determined by the number and the type of areas included in each shop.

Area	Pupil Stations	Time: Periods			Total
		7	8	9	
Woodworking	8	48	54	90	192
Metalworking	8	14	30	60	104
Electrical	4	10	24	30	64
Planning	8	correlated with all areas			

The planning area has no definite time allotment because its use is functional and should be correlated with the work in all of the other areas in each shop.

Strict adherence to this schedule is not necessary. Obviously individual interests and abilities will determine the amount of time each pupil will spend in each area.

The number of pupil stations indicates approximate class distribution. It does not necessarily follow that all stations will be filled at the same time. Pupil stations indicated for the planning area are comprised of the workers from the other areas.

The shop area and the work stations available will determine the class size. The maximum enrollment should not exceed 20 pupils per class for best results.

The described program is designed to provide a more uniform type of exploratory experiences for the junior-high-school students. This will enable the senior high school to offer a more advanced type of program based on the introductory work provided in the junior-high-school experiences.

Contrast Color Painting for Shop Safety

*Paul G. Hausman**

The problem of promoting shop safety has always been a responsibility of every instructor and supervisor of industrial and vocational training programs. One of the greatest contributions to shop safety can be secured at a minimum cost by the painting of walls, ceilings, and machines with light contrasting colors.

Visits to many school shops, both large and small, in private and public schools, show that walls, ceilings, and floors, are not painted at all, or if painted, usually in a dead, light absorbing color. The color gray was the most frequently used. The drab colors of the surrounding walls in these shops absorbed at least 50 per cent of the lighting. The machines in these shops usually are painted either black or dark gray, absorbing still more of the precious lighting which is so vital for safe working conditions. The situation just described is one of the most important factors which contribute to hazardous working conditions in the average industrial-arts and vocational school shop.

Some time ago, as assistant director of an aircraft school in which over one thousand men were being trained, I carried on some experiments with colors on walls, ceilings, and some equipment. I found that not only did the light colors increase the efficiency of lighting in general, but it also resulted in more accurate work accomplished with less fatigue and eyestrain. At this particular time there was not available, to my knowledge, any scientific studies or experiments showing results of light color painting of machines and its effects on accident reduction.

A year later I joined the faculty of the School of Engineering and Architecture as head of the department of shop practice at which time we were operating a National Defense Training program in machine tool operation and welding. These classes were held in addition to our regular university classes; therefore, classes were in session throughout the night. Our shops were typical of most school shops; all machines were driven by overhead shafting and belts, with incandescent lighting over each machine. The walls were painted in a drab color and the machines were painted the usual dead gray color. Our accident rate was not serious but typical of a shop of that type. A number of men were having eye trouble including a few instructors which indicated that our lighting was inadequate. In order to remedy the situation the natural thing to do was to check the lighting with a light meter and make a complete study of each machine for proper positioning in the shop and proper guarding. The second step toward shop safety was to motorize all machines. This project eliminated all belt hazards and gave increased light throughout the entire shop. We were also able to place our lights in a better position after the removal of the overhead shafting and belting. Then the painter was called in to take the next step of our shop safety plans. All walls and woodwork were painted a light color. This new condition was very noticeable in the lighting throughout the shops.

In reading of the study made by the DuPont Research Laboratories and the results obtained in accident prevention in various industrial plants by the use of contrast color schemes in painting machines, I decided to experiment with this idea in our shops. A DuPont representative was consulted on the scientific methods developed by their research laboratories. This painting scheme is being practiced widely throughout industry with amazing results. The advantages claimed for this color painting are as follows: increased production, reduced personal injuries, better working conditions, and improved worker morale. A number of different color combinations may be used, the machine may be painted in a light buff color, and the immediate work area of the machine painted in a light contrasting color so that the work area will be lightened and free of shadows. Controls on the machine may be painted red so as to attract immediate attention to the operator.

During 17 months we trained over 5000 students and servicemen comprising a monthly total of 54,764 man-hours. We had only two accidents during this time that required the trainee to miss classwork. Fluorescent lighting was installed which amplified the benefits of contrasting colors and eliminated practically all shadows. This new lighting installation, no doubt, contributed greatly to accident prevention, but even without the benefits of this lighting system the results of light contrasting colors on machines will give amazing results to any shop instructor who is trying to reduce accidents. It is true that this color scheme is a radical change from the old dark colors that once were used generally in workshops. But this change grows on an individual in a short period of time after which one feels out of place in the old conventional painted shop. There is no reason why the shop should not be a pleasant place in which to work. Students will take much more interest in keeping equipment clean, and in general, good housekeeping and a better morale is promoted throughout the shop organization.

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Mechanical Drawing at Taft, California

*George R. Watson**

During the past 25 years about one third of all students (boys and girls) have enrolled in mechanical drawing classes at Taft Union High School and Junior College at Taft, California. This is considered a very large percentage as compared to most schools throughout the country.

The reason for this heavy enrollment in mechanical drawing may be due to several reasons:

1. Efficient counseling by our school counselors.
2. The vocational need as recognized by the parents.
3. Presentation of the subject by above average teachers.
4. All equipment provided by the school at no cost to the student.
5. Department is equipped with the best and most modern drawing equipment which includes all duplicating processes.
6. The stimulus of oil production, the community's chief industry, on mechanical and scientific pursuits.

A very generous administration and board of trustees authorized the construction of a new building in 1937 to house the mechanical drawing department. The head of the department was given a free reign in the designing and equipping of the drawing rooms and as a result we have what we think is the best designed and equipped drawing rooms to be had. Each room has abundant north light with air conditioning and specially designed individual drawing desks. Advanced students have available the best drafting equipment which includes drafting machines, tracing table, complete wrico lettering set, electric erasers, and many other special mechanical aid items which are to be found in many oilfield drafting rooms.

The system used in caring for the equipment checked out to each student and the special drawing desks were designed by the head of the department after many years' teaching the subject and studying the problem of caring for each student's equipment.

A wall cabinet is provided containing a drawer for each student in each class. The desk has a recess into which the student places the drawer after taking it from the cabinet upon entering the room. At the end of the period the student returns his drawer to its proper place in the cabinet. The teacher locks the cabinet at the end of the period, to be unlocked by him when the class returns the next day.

Each student has a large envelope in which he keeps his finished drawings. This envelope is found in the compartment in the rear of the desk.

The drawing boards are kept in an enclosed rack in the left side of the desk and a smaller compartment on the right side of the desk provides a place for the student to keep the usual armful of books which he carries from class to class, as well as a storage place for the individual desk lamp provided for days when the natural light is not sufficient. On each desk in a convenient holder are placed two triangles and a scale which are used by every student using the same desk. A *T* square also hangs on the left end of the desk. The desk equipment is checked at the end of each period by the student at the front desk in each row.

Eight 500-watt lamps furnish ample semi-indirect lighting for 25 drawing desks in a room that is 25 by 40 ft., and an electric floor outlet for each desk allows the use of an additional desk lamp when needed.

The desks, as well as the floor, have a covering of battleship linoleum which is good insurance against breakage of instruments by dropping and also cuts down the noise in the room caused by moving stools which are provided with crutch tips.

The drawing board blocks have a strip of rubber attached to the top edge where it makes contact with the board; this reduces the clatter of boards to a minimum.

One large blackboard is located at the front of the drawing room while all other wall space is covered with tack board which may be used for exhibiting special work and for posters and charts as desired.

Our blueprint room is equipped with the following duplicating equipment:

1 — vertical printing machine
1 — continuous 42-in. printing machine
1 — print washer
1 — continuous sheet dryer
1 — B. & W. developing machine, 42 in.
1 — three-foot paper trimmer
2 — light proof sensitized paper dispensers

Plentiful bench room, drawers, and cupboard space also are provided.

We have a short course in duplicating work in which advanced students are taught to operate, adjust, and care for all machines used. Upon completion of the course they are qualified to take a position

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FIG. 1

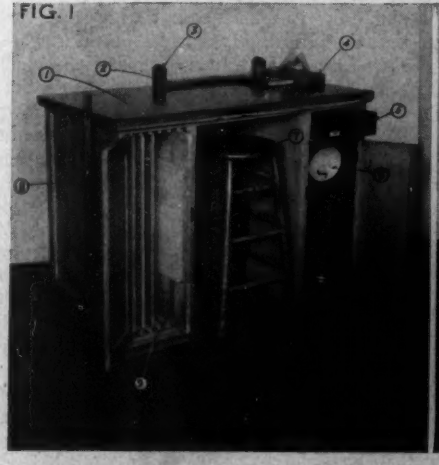

FIG. 2

Fig. 1. Drawing desk. (1) Battleship cork linoleum; (2) board rest; (3) rubber tips; (4) holder for desk tools; (5) metal drawer; (6) desk lamp; (7) stool; (8) T square; (9) drawing boards. Fig. 2. Rear of drawing desk. (10) Envelopes; (11) compartment door

Fig. 3. Wall cabinet

Fig. 4. Corner of the drafting room showing a part of the wall cabinets, one of which is open for the class.
Fig. 5. Blueprint room

as blueprinter in any drafting office. Many boys and girls, after having taken this course, have worked during summer vacations at this work.

The system used at Taft Union High School for caring for the instruments for which the student is responsible has proved a great success, and has been adopted at many other schools in the western states. It does away with the old excuse of a student that he has forgotten or lost his key.

Printing Grows Into Big Business

*E. Burnham Dunton**

The first record we have of a financial transaction in the printing business in Colonial America is the testimony of Stephen Day that the cost of printing the *Bay Psalm Book*, exclusive of paper, was 33 English pounds. Most of that expense represented labor, and since it has been estimated that it took about a year to produce it, one must admit that the printing industry in America began under rather modest circumstances.

In 1941 the value of the products of the combined graphic arts industries was nearly three billions of dollars. The U. S. Department of Commerce has published an estimate that this figure may jump to four and one-half billions in 1946. A chart showing the approximate relationship between the value of newspapers, periodicals, books, and commercial (job) printing is shown for the decade 1929–39. See Chart I. Estimated volumes are also shown for the year 1946 if the gross national product reaches 165 billions of dollars.

The status of the newspaper, periodical, book and general commercial (job) printing in the year 1939, according to the U. S. Census of Manufacturers, is shown in Table I.

Contrary to prevailing opinion, the technological development of the printing industry has effected an increase — rather than a reduction — in the number of workers at the trade. Statistics show that the number of wage earners constantly increased, each year, for the fifty years preceding 1929. The greatest increase was made during the decade from 1880–90, when a number of our most important laborsaving machines were perfected. Nor have the high-speed presses of the past two decades produced any demoralizing effect upon the number of workers. All of these improvements, both in machinery and methods, have simply made it possible to do more printing at less cost, and industry and the general public have eagerly consumed the increased output of the presses. In the year 1939 there were more than three times as many wage earners in the printing industry as there were fifty years previous.

Employment Opportunities

Since employment opportunities in any industry depend largely on the magnitude

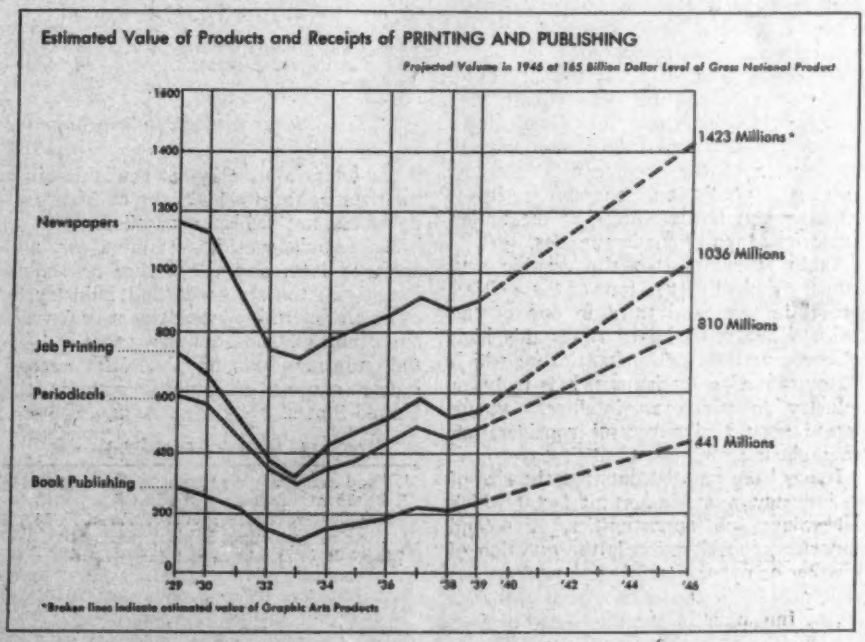

Chart I

*Asst. Mgr., Department of Education, American Type Founders, Elizabeth, N. J.

of that industry, we should determine the status of the printing industry in relation to other major industries.

The study of a few facts about the printing industry discloses that it is one of the giants of American industry. Its high place on the list of major industries with respect to number of establishments, number of employees, wages, salaries, and value of its products, is undoubtedly due to the fact that printing is closely related to and serves all other industries. It helps every manufacturer advertise and sell his products, label his packages, keep his accounts, and bill his customers.

Printing is also a service to every consumer, and every American is a consumer of manufactured products. Printing is one of the most potent social influences in American life. The power of the press is a dominant factor in determining public opinion, electing political leaders, and in formulating our laws. It is natural that such a dynamic force should flow from the hands of a giant.

Because the pre-eminence of the printing industry is rivaled only by those industries which contribute to the basic essentials of modern civilization; namely, food, clothing, shelter, and transportation, one may conclude that printing, too, is a basic essential to our mode of living.

A series of tables are shown which present a graphic picture of the relation of printing to other major industries with respect to several basic factors by which industries are often compared.

We often think of a certain city as a textile city or by some other equally descriptive identification. An article was published a few years ago which showed the relation of the graphic arts industry (printing, publishing, engraving, lithographing and bookbinding) to the major industries of ten of our large cities.

Table II shows that the graphic arts industry ranked first in four of these cities, second in five, and third in one of the cities. When an industry ranks this high upon comparison with industries for which cities are nationally famous, it is truly an industry to which an intelligent young person should give careful consideration when choosing his vocation.

It has been pointed out that the size of an industry is one important factor which determines job opportunities. A second important consideration is the question of whether or not the training of workers has kept pace with the employment demands of the industry. In the past several years the training of workers for the printing industry has lagged far behind placement opportunities, and the industry will be faced with a shortage of workers for many years. This condition makes the choice of a vocation in the printing industry especially attractive. A discussion of training opportunities is presented in another section of this booklet.

TABLE I

	No. of establishments	*No. of wage earners*	*Wages paid*	*Value of products*
Newspapers	7,309	97,251	$164,718,489	$910,188,611
Job printing	9,595	96,039	132,994,964	515,435,609
Periodicals	2,558	21,421	33,552,601	468,846,754
Book	1,396	22,773	33,638,091	236,752,293

TABLE II

The Relative Rank of the Graphic Arts Industry* in Ten Major Cities of the United States

City	*Relative Rank*		
	1	2	3
Philadelphia	★		
Boston	★		
San Francisco	★		
Washington	★		
New York		★	
Chicago		★	
Los Angeles		★	
St. Louis		★	
Detroit		★	
Cincinnati			★

*In relation to the other industries.

The Bureau of Labor Statistics in January, 1942, reported the employment of women in the printing industry in the United States as follows (the percentages are undoubtedly higher at this time):

Total printing industry	23.7
Commercial printing	20.7
Bookbinding	46.1

Status of the Printing Industry in 1939

No later information is available since the data of the 1941 Census of Manufacturers has not yet been compiled.

Before one considers training for, and entrance into, any occupation he should investigate the status of that industry in order to determine employment and wage opportunities. Table III shows that in 1939 the printing industry had the second largest number of establishments in the United States.

TABLE III. Number of Establishments*

1. Food and kindred products	51,488
2. Printing, publishing and allied industries	24,878
3. Apparel and other finished products made from fabrics and like materials	20,206
4. Lumber and timber basic products	11,520
5. Machinery (except electrical)	9,506
6. Chemicals and allied products	9,203
7. Iron and steel and their products, except machinery	8,994
8. Furniture and finished lumber products	8,457
9. Miscellaneous industries	7,699
10. Stone, clay, and glass products	7,024

*From U. S. Census of Manufacturers, 1939.

Tables IV and V indicate that although, in 1939, printing stood in sixth place in the total number of employees, it stood first in the number of salaried employees. Since salaried employees are usually permanent employees, this is a significant fact and gives an additional indication of the stability of employment in this industry.

TABLE IV. Employees in Manufacturing Establishments

1. Textile-mill products and other fiber manufacturers	1,163,451
2. Food and kindred products	1,132,625
3. Iron and steel and their products, except machinery	1,127,413
4. Apparel and other finished products made from fabrics and similar materials	849,464
5. Machinery (except electrical)	680,297
6. Printing, publishing, and allied industries	552,505
7. Automobiles and automobile equipment	460,419
8. Chemicals and allied products	404,249
9. Lumber and timber basic products	398,575
10. Leather and leather products	359,857

TABLE V. Salaried Employees in Manufacturing Establishments*

1. Printing, publishing and allied industries	124,060
2. Iron and steel and their products, except machinery	105,207
3. Machinery (except electrical)	95,376
4. Food and kindred products	92,528
5. Chemicals and allied products	54,906
6. Electrical machinery	54,769
7. Textile-mill products and other fiber manufacturers	54,573
8. Automobiles and automobile equipment	44,884
9. Apparel and other finished products made from fabrics and similar materials	37,140
10. Miscellaneous industries	30,871

*From U. S. Census of Manufacturers, 1939.

Wages and Hours

Probably of most importance to the worker and his family is the amount of wages that can be expected for his labors. At least, it is as important as permanency of employment. Both are requisite to social contentment and advancement. A third factor, of slightly less consequence, is the stability of income.

It has been shown, in the foregoing, that printing and publishing rank high among the country's leading manufacturing industries in permanency of employment. This being true, the workers in this industry would be more fortunate than those in most lines, even if their weekly earnings were not as large. The thrifty man realizes the advantages of continuous employment at a moderate wage. It provides a dependable, annual income, whereas the periodic, or intermittent job, even with a larger weekly pay envelope, may show lower total receipts for the year's work. But let's take a look at the printer's wage possibilities,

also the opportunities that his trade offers for steady income compared with other lines of work.

Since 1907 the trend in wage rates in the printing industry has increased steadily, except for two years during the depression, and even then it receded but little. Table VI shows this trend, which is based on the year 1929 being represented as an index of 100. This table also shows that in 1907 wages were only 30 per cent of what they were in 1929 but that in 1940 they were 12.2 per cent above the 1929 level. Likewise, we see that in 1907 the work week was 22.4 per cent longer than in 1929 but that in 1940 it was only 89.4 per cent as long as in 1929. Thus it is obvious that there has been a persistent trend toward a shorter work week and an increased hourly wage since 1907.

TABLE VI. Trend in Hourly Wage Rates since 1907

*Index of Union Hourly Wage Rates and Weekly Hours in All Book and Job Printing Trades—1907 to 1940**

Year	Hourly wage rates	Weekly hours	Year	Hourly wage rates	Weekly hours
1907	30.0	122.4	1924	92.0	100.2
1908	33.3	116.8	1925	92.9	100.3
1909	35.7	115.8	1926	95.0	100.1
1910	37.6	115.4	1927	97.3	100.1
1911	38.6	115.4	1928	98.7	100.1
1912	39.3	115.3	1929	100.0	100.0
1913	40.0	115.3	1930	101.8	99.9
1914	40.9	115.3	1931	102.5	99.9
1915	41.1	115.4	1932	101.4	96.1
1916	41.7	115.3	1933	95.8	95.1
1917	43.2	115.3	1934	98.4	91.8
1918	47.8	115.3	1935	100.6	90.4
1919	58.9	115.2	1936	103.5	90.5
1920	76.9	110.9	1937	106.7	90.3
1921	84.7	102.1	1938	110.4	89.9
1922	85.0	100.8	1939	111.2	89.6
1923	88.3	100.2	1940	112.2	89.4

*Hart, "Printing, American Industrial Giant," 1945.

Table VII shows the average weekly wages for the four-year period, 1935–38, and gives a typical example of the relation of wages in the printing industry to those in eight other leading industries. We see that the printing industry leads all of these industries in this respect. These wages were considerably higher during the period of the war. It should also be noted that these are *average* wages for entire industries and that while some workers were paid less, others were paid considerably more wages per week.

TABLE VII. Weekly Earnings Combined in Manufacturing Industries*

Combined Yearly Averages 1935–38 Inclusive	
Printing and publishing	$32.21
Transportation equipment	29.12
Machinery	25.62
Iron and steel	25.17
Nonferrous metals	23.43
Food	22.80
Stone, clay, and glass	21.84
Lumber	19.25
Textiles	16.51

*Hart, "Printing, American Industrial Giant," 1945.

At this point it would be interesting to note what the specific wages are for some of the major occupations in the printing industry. The latest data available at this writing appears in *Printing Yearbook & Almanac for 1944–1945.*

An examination of the basic wage scales for cylinder pressmen and compositors, as of November 1, 1944, shows that wages in these occupations compared favorably with wages in the skilled war industries. The basic wage scale for compositors varied from a low of $32.72 per week in Fall River, Mass., to a high of $62.40 in New York City. These figures are for a 40-hour week with suitable overtime pay as in other industries. At the same time the basic wage for cylinder pressmen varied from a low of $36 in New Bedford and Worcester, Mass., to a high of $61.50 in Jersey City, N. J.

TABLE VIII

	Compositors	*Cylinder Pressmen*	*Bookbinders*
Boston	$48.80	$47.00	$47.00
Chicago	61.80	57.00	50.00
Cincinnati	54.00	47.50	43.50
Detroit	56.00	56.00	50.00
Los Angeles	51.40	47.80	—
New York	62.40	60.00	64.00
Philadelphia	54.00	52.80	45.00
San Francisco	58.50	54.25	—
St. Louis	51.20	47.37	48.00
Washington	51.30	51.30	46.00

From the Printing Yearbook & Almanac, 1944–45.

Table VIII shows the wage scale for compositors, cylinder pressmen and bookbinders, as of November 1, 1944, in the same ten cities studied in Table II.

Couple the foregoing information with the fact that employment in the printing industry is far more stable than in any other industry and we find that printing holds a unique position as compared with other manufacturing industries.

Opportunities for Advancement

In 1939, according to the Census of Manufacturers, the printing and publishing industry reported 124,060 salaried employees and 324,535 wage earners, indicating that for each salaried employee there are 2.6 wage earners. This ratio is far more favorable than that existing in any other industry, and indicates that the chances for promotion to supervisory and junior and senior executive positions are considerably more probable. This results in larger incomes and a higher standard of living for printing employees. The ratios existing between the number of salaried employees and wage earners are shown below for several of the larger industries:

TABLE IX

Industry	*Ratio of salaried employees to wage earners*
Printing and publishing	1 to 2.6
Machinery	1 to 5.2
Transportation equipment	1 to 7.7
Nonferrous metals	1 to 7.9
Food	1 to 8.9
Iron and steel	1 to 9.2
Stone, clay, and glass	1 to 10.5
Forest products	1 to 14.6
Textiles	1 to 20.0

The Future of the Printing Industry

Estimates of postwar business volume are based primarily on two factors: trends in past volume and anticipated new markets. A study by the U. S. Department of Commerce reveals that for many years the value of the products of the graphic arts industry as a whole has closely paralleled that of the gross national product. This is true because the graphic arts industry serves all industries and all consumers. With these facts in mind it is reasonable to assume that the relationship between the volume of graphic arts industries and the gross national product will continue to be close, and that the anticipated trend in the value of the gross national product may be used as an index for estimating the trend in volume of business for the graphic arts industry. Chart II shows the relationship that existed for the decade 1929–39.

The Department of Commerce has estimated that the gross national product could reach 165 billions of dollars in 1946 (at 1942 price levels), or 142 billions at 1940 price levels. These figures are an estimate and in no sense are a prediction or forecast. However, there is ample evidence to permit us to assume that there will be a business boom in the next few years because of the huge backlog of unsatisfied needs and desires of the average

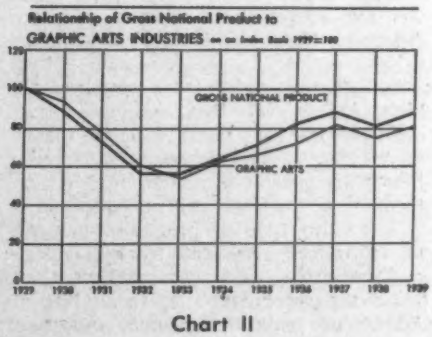

Chart II

consumer. Chart 3 shows what we may expect for business volume in the graphic arts industry at various levels of gross national product. It is possible that the production of graphic arts products may reach a value of more than 4 billions of dollars, or an increase of about 75 per cent over 1939.

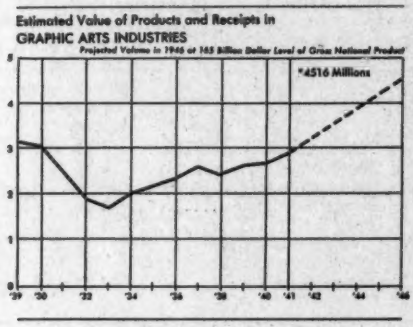

Chart III

Advertisements of many new products which will not be available to consumers for many months, or for a few years in some cases, have begun to appear in magazines and newspapers. All sorts of new household appliances, fabrics, plastic products, radio and television, have been promised. The competition between manufacturers of automobiles, tires, and electrical products, will be very keen as a result of new developments in chemistry, electronics, and mechanical invention. The promotion of all these products will require huge printing and advertising programs.

With this optimistic picture before us it appears that the future employment opportunities in the graphic arts industry should be very promising.

Training Opportunities in Schools

There are three types of printing education in the public and private schools. Printing, and the broader field of graphic arts, is being offered in thousands of junior and senior high schools as a phase of the industrial arts program. In this capacity the graphic arts provide opportunity for the student to apply his English, art, social studies, and arithmetic in the creation of such wholesome projects as the school paper, programs, booklets on hobbies, club activities, and original poetry. In these schools the graphic arts provide exploratory and prevocational experiences in addition to their rich general educational values.

In the vocational or trade schools on the high school level, the printing program definitely prepares youth to enter the industry with a high degree of skill and a broad knowledge of related information, together with a good general education.

The third type of program commonly offered is that in the state teachers colleges and universities. They prepare youth to teach the graphic arts in the industrial-arts departments of the junior and senior high schools. Vocational school teachers are drawn from the trade and are given certain professional courses to prepare them to teach. These courses are given under the direction of the state board for vocational education in the various states. The International Typographical Union lesson sheets are recommended for and used by many of the vocational schools.

There has always been a shortage of teachers of printing and graphic arts for the industrial-arts departments of the junior and senior high schools. A large number of state teachers colleges and universities now have training facilities to prepare teachers for this important work. High-school printing teachers should encourage the better students in their senior class to consider entering this expanding phase of teacher training. Local guidance counselors and school principals should bear in mind the need for teachers in this work and provide individuals and groups with information about teacher-training opportunities in their state.

The printing and graphic arts courses in the secondary schools and in the teachers colleges generally offer instruction in type composition, design and layout, stonework, platen presswork, linoleum block printing, silk-screen printing and bookbinding. Some high schools offer instruction in dry point etching, stone lithography, machine composition, and cylinder presswork.

The vocational schools offer foundation and advanced courses in most of these subjects plus courses in high-speed cylinder presswork, estimating, stereotyping, electrotyping, photoengraving, and in offset lithography including camera work, platemaking and offset presswork.

In all types of schools, English, arithmetic, art, and the history of printing are an essential part of the graphic arts curriculum. Other courses which are recommended as desirable are social studies, chemistry, physics, typewriting, and public speaking.

For many years the Carnegie Institute of Technology has offered a college degree course in printing which has as its objective the training of men for executive positions in the printing industry and its allied fields. Graduates of the Department of Printing at Carnegie hold important executive positions in printing and publishing plants, advertising agencies, and in the sales forces of manufacturers of printing equipment and supplies. Also many Carnegie graduates enter the teaching profession. Because of the excellent placement record of Carnegie graduates, and since the value of this kind of training is recognized nationally, other large colleges are planning to establish similar departments.

The Rochester Institute of Technology has an outstanding graphic arts program on a post-high school level. Its Department of Publishing and Printing was organized in 1937. Its extensive equipment, facilities and curriculums are designed to fit the needs of those who are interested in careers in the publishing and printing business on the technical or professional level.

The Rochester Institute of Technology offers scholarships in publishing and printing sponsored by leading daily papers of New York State. Information about the scholarships, which are open to high-school seniors and graduates, may be obtained from high-school principals or by writing to the Department of Publishing and Printing, Rochester Institute of Technology, Rochester, N. Y. Scholarships are open to both young men and women. The Department of Publishing and Printing has issued an excellent vocational guidance pamphlet, "If You Are Considering Publishing and Printing," which is available upon request.

Types of Jobs and Qualifications Necessary

The printing industry offers a great variety of opportunities for men and women to apply their inherent talents and acquired skills. Jobs vary from the highest type of creative writing and art work to the simple tasks of making paper pads and remelting stereotype plates. Most of the occupations in the industry require people with average or better than average intelligence and education, since printing is an exacting and meticulous type of work. There are excellent opportunities for high-school graduates.

In recent years industrial leaders have been seeking an increasing number of college trained young people for junior executive positions. Another section in this booklet explains present and proposed opportunities for securing training in the schools to prepare them to enter the printing industry.

Some of the occupations require the worker to remain on his feet most of the working day. Other workers sit most of the time. Many jobs require considerable physical stamina while others require greater mental exertion.

Since printing is one of the most important major industries, serving all other industries, it has a great influence on our social and industrial progress and on national prosperity. Because of this, and its high wages, it is a very satisfying field of work. The following analysis of the major jobs in the printing industry, together with some special physical or occupational qualifications which are desirable, will be helpful to young people who are considering printing as an occupational choice.

Designer and Layout Man

Job Requirements: Creates all kinds of printed matter. Plans illustrations. Decides on type faces to be used. Decides on shape and size of the paper and typographic masses. Makes layouts and dummies. Contacts photoengravers, photographers, paper salesmen, and commercial artists. Decides on color and finish of paper and color of inks.

Qualifications: Must have a resourceful, creative mind. Must know fundamental principles of design and layout. Must be familiar with appropriate use of type faces, ornaments, and illustrations. Must be well acquainted

with various printing processes, sizes of presses, and technical limitations of equipment. Must know proper use of colors. Must be well informed on the sizes, finishes, and colors of paper stock. Has to meet many people and must possess a genial personality and be tactful.

ESTIMATOR

Job Requirements: Prepares costs based on specifications developed by customer and designer. Often confers directly with customer. Figures production costs and develops a scale of rates for various operations in the shop. Has to figure amount and cost of type composition, paper, ink, and other materials and operations. Decides on press to use and plans the run. Prepares complete estimates and often prepares contract.

Qualifications: Has to be quick and accurate in the basic fundamentals of arithmetic. Has to understand every operation in the plant. Must be well informed on processes in allied industries. Must have ability to meet people favorably. Since promptness and the amount of the quotation determine whether his employer secures the contract for a job, the estimator must be one who can work accurately under stress and yet remain congenial.

HAND COMPOSITOR

Job Requirements: Except in the large plants, the compositor has to choose the style and sizes of type faces. He sets type, spaces it properly, and often makes up the pages including cuts, rules, borders, and ornaments. In small and medium-sized shops the compositor proofs his composition and corrects the errors in it. He also distributes the type and other elements in type forms.

Qualifications: Must know the fundamental operations in typesetting and be well informed on the art of typographic display. In the average shop he must have a good knowledge of English and spelling since he should be able to catch errors in the copy before setting the type.

MACHINE COMPOSITOR — LINOTYPE AND INTERTYPE

Job Requirements: Must change, set, and adjust parts of the machine for setting lines of various lengths and thicknesses. Is responsible that slugs are trimmed accurately to all measurements. Changes magazines, puts metal in pot, and dumps sticks. Operates keyboard. Has to clean spacebands regularly as well as certain parts of the machine.

Qualifications: Although machine operation has a certain fascination for the average operator, it is a monotonous occupation and often produces a severe nervous tension upon some individuals. "Nervous" persons should not attempt to become machine operators. In small and medium shops the machine compositor often has to determine the style and display of types used. He very often has to operate from poor longhand copy. Generally, it is therefore desirable that he have a good knowledge of the principles of type composition and display, and that he be capable of noting and correcting errors in spelling and grammar.

STONEMAN

Job Requirements: Imposes type pages and locks type forms in chases for the presses. Checks type forms for squareness and register. Often has to pull stone proofs. Responsible for allowance for margins and conditions which expedite the work of the pressman. Distributes furniture, reglet and other lock-up materials.

Qualifications: Must be able to lift heavy forms. Must be meticulous in order to prevent delays when form is on the press. Has to be co-operative with compositors, makeup men and pressmen.

CUTTER

Job Requirements: Checks on amount of paper and accuracy of size of stock determined by estimator. Requisitions stock from stockroom or obtains it himself. Stacks stock in cutter and operates cutter. Responsible for delivering stock to the pressman.

Qualifications: Must lift heavy piles of stock. Responsible for cutting stock accurately. Must know arithmetic.

PRESSMAN

Job Requirements: Oils press and keeps it in repair and adjustment except in the very large shops where an assistant does it. Inks press. Occasionally has to mix inks to obtain special colors. Inserts type form in press. Makes the job ready to run by lining up the job, adjusting the impression (make-ready), setting the grippers. On automatic presses the pressman has to adjust feeder and delivery mechanisms. Checks and controls drying of the ink. Responsible for the correct printing of the job, including ink control, alignment, register and any special printing quality required.

Qualifications: Has to have good understanding of the fundamentals of mechanics and considerable skill in the adjustment of mechanical controls. Must have technical knowledge of the relation of various kinds of inks to various kinds of papers. Must know how to obtain special colors by mixing various inks. Must take pride in having work square, clean, neat, and accurate. Has to lift heavy type forms and piles of paper. Good eyesight very important.

PROOFREADER

Job Requirements: Compares proof with copy. Checks for, and marks, all typographic errors, indentions, and grammatical errors. Verifies dates, numbers, and foreign words and phrases. Checks sequence of folios. Checks for uniformity of style. Verifies credit lines. Questions author on apparent contradictions and ambiguities. Checks revise and press proofs. Passes on sheet for final O.K.

Qualifications: Should have good general education and keen sense of visual perception. Must have good knowledge of English grammar. Must know office style and proofreader's marks. Knowledge of type composition is helpful. Accuracy as to details is essential. Women are often employed as proofreaders.

BINDER

Job Requirements: This is a general term loosely applied to a variety of jobs. Some bindery operations are: cutting, jogging, folding, padding, gathering, stitching, perforating, drilling, wrapping, labeling, and bookbinding. In large book publishing houses bookbinding machines are used and at various stations on the machine unskilled, semiskilled, and skilled operators are needed. Many women are employed in bindery operations.

Qualifications: Generally must be neat, clean, and fast.

OFFSET CAMERA OPERATOR

Job Requirements: Photographs in artificial light the original art work, type proofs, photographs and drawings necessary to the finished job. Mounts material to be photographed on copy board; adjusts camera for proper positioning of lens and copy to insure correct focus and size of image; exposes films or plates to properly reproduce copy; performs developing operations and dries films or plates; also makes film or glass positives by contact with negative.

Qualifications: Must be familiar with photographic processes, especially copying techniques as applied to reproduction work. Handling, bending, reaching, color vision, standing, light lifting, and carrying required. Previous experience in commercial photography is valuable.

OFFSET FILM STRIPPER

Job Requirements: Interprets job ticket in order to make layout on paper in conformity with plan of job; arranges negatives or positives in position on layout sheet to produce complete form for contact exposure to press plate; practically all work done on light-transparent topped tables.

Qualifications: Mostly obtained on the job; must have ability to handle delicate films and work to accurate limits.

OFFSET PLATEMAKER

Job Requirements: Transfers image from negatives or positives to light-sensitive metal plates for printing on lithographic press; prepares grained metal plate by flowing light-sensitive coating evenly over surface in plate whirler; places coated plate in vacuum printing frame; places negatives or positives in contact with sensitized plate and makes exposure under arc lamp; develops plate according to formula to bring out image; renders non-image areas ink-repellent by chemical etching; applies gum arabic protective coating to plate.

Qualifications: Must be familiar with lithographic processes; some knowledge of chemistry helpful; on-the-job training. Previous experience in commercial photography is valuable.

OFFSET PRESSMAN

Job Requirements: Makes ready and tends lithographic printing press; installs plate on press; adjusts pressure for proper printing; cares for and adjusts blanket to maintain quality work; adjusts water and ink rollers for correct operation; mixes inks; operates press and runs job; checks printed sheet at regular intervals; keeps press in good operating condition.

Qualifications: Several years' experience are required for best quality results; general knowledge of printing as background; familiarity with paper, inks and offset presswork procedures essential.

The Census of Manufacturers records about sixty other occupations in the graphic arts industry. These encompass such a wide variety of activity requiring varying degrees of skill, technical knowledge, and education that the job requirements in this industry will match the qualifications of most any normal individual.

A few references on the study of occupations in the graphic arts industry follow: *The Printing Trades and Their Workers,* Florence E. Clark, International Textbook Company, Scranton, Pennsylvania, 1939; *The Composite Analysis of the Printing Trades,* National Graphic Arts Education Association, Washington, D. C., 1940; *Graphic Arts Occupations,* R. Randolph Karch, Industrial Arts

and Vocational Education Magazine, Milwaukee, Wis., November, 1942.

Printing Occupations in Relation to Physical Handicaps

Physical handicaps reduce the employability of injured persons and narrow the fields of occupational life into which they may enter. There are many occupations in the printing industry which handicapped individuals may perform efficiently. A number of these, with the acceptable handicaps, are listed below:

ESTIMATOR

Work consists of determining costs and estimating prices of printing jobs. Must have good knowledge of all production problems, especially as they relate to the cost of finished job. Partial deafness and one artificial leg would not result in loss of efficiency. Loss of one arm would be a handicap, although not too serious.

LAYOUT MAN

Ability to write, draw, and design is necessary in the planning and designing of all types of printed jobs. Should have general knowledge of printing processes, also good understanding of typography and trends in design. Both arms needed. Efficiency would not be greatly affected by the use of one artificial leg.

HAND COMPOSITOR

The setting of type of various sizes and faces requires understanding of composing room problems. The hand compositor is required to move around considerably. Partial deafness and one artificial leg not a serious handicap. Must have both arms, one good leg, and good eyesight.

MACHINE COMPOSITOR

Requires ability to operate the keyboard and make minor adjustments to operating mechanism. Must have both arms and hands and good sight. Partial deafness and one artificial leg not a serious handicap.

PROOFREADER

Work consists of detecting errors in the proof before the job is placed on the press. Requires thorough grounding in the essentials of grammar, spelling, and English construction, also, ability to find defective letters and improper spacing. Requires good eyesight, good hearing, and both arms. Loss of one leg not a handicap.

STONEMAN

Makes up and locks up forms of type in chase preparatory to placing on the press. Requires good sight and both arms. Partial deafness and one artificial leg not a serious handicap.

FOREMAN OF COMPOSING ROOM OR PRESSROOM

Work is supervisory in character. Requires a wide experience in shop operations and management. Requires fair to good sight and hearing. Loss of one arm and one leg not detrimental to efficiency.

PLATEN PRESSMAN

Work consists of making-ready and feeding the job to the press, also, making necessary adjustments to ink fountain and other operating parts of the press. Operator is required to stand and use both hands. Good eyesight is essential. Partial deafness and one artificial leg not a handicap.

CYLINDER OR AUTOMATIC PRESSMAN

Experience and skill required in adjusting and making-ready on cylinder and automatic presses. Good sight and the use of both hands essential. Partial deafness and the loss of one leg not a serious handicap.

WEB PRESSMAN

Work consists of operating newspaper presses. This requires good sight and hearing. Loss of a leg or arm would prevent doing work of this character.

PRINTING SALESMAN

Requires good personality and a broad knowledge of processes. Work consists of selling and estimating printing jobs. Requires good sight and hearing. A person with one artificial leg could do this work.

PAPER CUTTER

Requires two hands and good sight. Partial deafness and loss of one leg would decrease efficiency slightly.

PROPRIETOR

Executive work, requiring over-all knowledge of processes and operations, as well as office and shop management. Must have leadership qualities. Should have good sight and hearing. Loss of one arm and one leg would not be too serious a handicap.

OFFSET CAMERA OPERATOR

Work consists of normal photographic operations: adjusting camera, exposing and developing film. Defective hearing, loss of one eye or leg would not incapacitate worker. Some moving around required.

OFFSET FILM STRIPPER, OPAQUER, ETC.

Work consists of placing negatives in position, on paper or glass, for transferring to plate. Defective hearing, loss of one eye or leg would not interfere with ability to perform these operations.

OFFSET PLATEMAKER

Work consists of preparing plates in sink, coating, exposing, developing, etching, and gumming up. Some moving around is required. Defective hearing, loss of one eye or leg would still permit carrying out operations.

OFFSET PRESSMAN

Work consists of making adjustments on press loading paper into feeder. Requires considerable agility during operations, bending, stooping, reaching, especially on larger size presses. Defective hearing, loss of one eye or leg would not incapacitate operator, though leg afflictions might hinder somewhat.

The Value of Graphic Arts in Vocational Guidance

Q. *What are the chances of getting a job in the graphic arts industry (printing, publishing, and allied industries)?*

A. It is obvious that the larger an industry is, the greater the number and variety of its job opportunities. The Census of Manufacturers reveals that the printing industry approached a three billion dollar volume of business in 1941 and the charts indicate that the graphic arts industry ranks among those industries which serve to meet our basic needs of food, clothing, shelter, and transportation. Therefore, the graphic arts is unquestionably a basic industry in modern civilization. The 1939 Census of Manufacturers shows that over 24,000 graphic arts establishments employed over 500,000 workers. An acute shortage of trained workers exists at this time and there is ample evidence that the demands for workers will exceed the supply for at least a decade.

Q. *What are the chances of holding a job in the graphic arts industry?*

A. Statistics show that employment in printing and publishing is the most stable of the nine major industries in the United States. The fact that the graphic arts industry has a far greater number of salaried workers in relation to wage earners (ratio of 1 to 2.6) than any other major industry is a definite indication of the stability of its employment conditions. Note that the graphic arts industry is not seasonal and that its position through the depression years was very favorable.

Q. *Are wages good in the graphic arts industry?*

A. Table VII shows that wages in the graphic arts industry are higher than in any other major industry. There has also been a progressive upward trend in wages for several decades, except for two years during the depression when they receded a total of only 6.7 cents per hour.

Q. *Are there many opportunities for advancement?*

A. Since the ratio of 1 salaried worker to every 2.6 wage earners is far more favorable than in any other major industry, it is apparent that the opportunities for advancement are exceptionally good.

Q. *Does the graphic arts industry have a promising future?*

A. Estimates by the U. S. Department of Commerce indicate that the industry has a remarkably promising future.

Q. *Do the schools offer adequate training facilities to prepare youth for entrance to the industry?*

A. While there is a need for the expansion of the present vocational school programs, and the creation of new programs in many cities, the number of vocational schools is fairly well distributed throughout the country.

Q. *How can the schools best serve the graphic arts industry?*

A. If the needs of industry are to be met by the schools, there must be an extensive expansion of the industrial-arts programs so that youth may secure exploratory experiences and thus become interested in entering the vocational schools preparatory to entering the industry. Guidance counselors, teachers of printing and teachers of occupational studies classes can render a great service to the industry and to youth by bringing these facts to the attention of junior and senior high school students.

Q. *Does the graphic arts industry offer any opportunities for the physically handicapped?*

A. The wide diversification of occupational qualifications required makes it possible for the graphic arts industry to

absorb workers with a variety of physical handicaps.

Q. *Is there opportunity for the employment of women?*

A. Women have always been employed in large numbers in bindery work and in Monotype keyboard operation. There have also been opportunities in editorial and art departments. In recent years women have successfully performed nearly all occupations in the graphic arts industry. One of the most promising opportunities for women is in offset camera work and in offset platemaking.

Postwar Unit for the Graphic-Arts Instructor

Harold H. Kirk and Sidney S. Schnsterman***

A new school term has started, and with it another opportunity to include linoleum block printing in the print shop. Many of our instructors in the armed forces are being discharged and are returning to their old jobs and will need prepared units and materials. It is for this reason that this unit is presented, because no course in printing should be without rubber and linoleum block cutting and printing.

The laying out, cutting, and printing of block prints is excellent experience in designing and applied presswork. The equipment and tools are very simple and inexpensive, thus making it possible for pupils to explore this type of early graphic reproduction. The work, also, is easily picked up and the boys and girls can carry on without too much direct supervision from the instructor.

Briefly, the tools and materials necessary for the activity consist of: a table or workbench, linoleum cutters, battleship linoleum blocks, hand brayer, printing inks, ink plate or a piece of glass, proofpress, platen press or bookbinding press, carbon paper, proof paper, good quality paper, tracing paper, thumbtacks or Scotch tape, linoleum block holder, cleaning fluid, and some rags.

Block printing from wood was one of the earliest forms of graphic reproduction. At the present time, block printing from linoleum is practiced extensively in the schools. Linoleum block printing offers a practical application of drawing, designing, composition, and color in the following items: school announcements, booklet covers, Christmas and Easter greetings, Valentine cards, personal stationery and cards, bookplates, bridge tallies, wall plaques, calendars, illustrations for tickets and programs, monograms, labels, draperies and hangings, and tint blocks for numerous jobs in printing.

Battleship linoleum in natural brown is preferred by most block printers, although cheaper linoleum may be used for certain types of work. Ready-made blocks may be purchased and are a big timesaver. If linoleum is used, it must be mounted on wood that will not warp very much. The material may be glued on or tacked on with small wire nails. Well-made blocks are generally mounted on five-ply, laminated plywood. Blocks may be secured from the woodshop, sawed to the desired size. Be sure the linoleum blocks are type high and that they are properly squared up. Mounted blocks are found to be more practical for the beginner because they can be used in conjunction with type and other ornaments when printed in a press.

Regular printer's oil ink has been found to be the best adapted for fine linoleum block work. Water-color ink, however, may prove to be more practical for work when small linoleum block hand presses are used; it is not true when power presses or any other metal presses are used. This is due to the fact that water-color ink may be washed off with water and thereby cause the iron metal parts of the press to rust. On the other hand, oil inks require gasoline or benzine as cleaners, and these will not rust the metal. It is also true that printer's oil inks are permanent.

Steps in the Cutting of the Linoleum Block

There are five necessary steps in making a linoleum block: (1) the design, drawing, or sketch, (2) transferring design upon the linoleum, (3) cutting or engraving the block, (4) inking and printing, (5) mounting or displaying prints properly.

1. *The design, drawing, or sketch.* Although it is possible to draw the design directly on the block, it is a difficult task unless you are able to visualize the finished product in reverse, especially the lettering. Remember the design on the block is always in *reverse* as compared to the finished print.

For beginners, it is recommended that in the first design straight lines be used, and no attempt should be made to cut them too fine. A silhouette type of design should be drawn as a first project. See Figure 1. Here effect is obtained through outline and mass arrangement. Several sketches should be made on either strong white paper or on tracing paper before deciding which one is to be cut. More complicated designs may be attempted later.

Fig. 1. A good job for the beginner

2. *Transferring design upon the linoleum:* A good practice in linoleum block work is to draw the design on tissue paper, transparent onionskin paper, tracing paper, or on thin transparent bond paper. If the design is drawn on opaque paper, a copy must be made on thin tracing paper to enable you to see the design on the reverse side of the paper. Place a piece of carbon paper face down upon the block. Next, place the tracing face down on the carbon paper and thumbtack it or tape it down. Be sure the thumbtacks are outside the drawing or in spots inside the drawing that will be cut out of the block. Use a hard lead pencil to trace the outline of the design on the linoleum with enough pressure to effect a transfer. The linoleum may be surfaced with either a thin coat of white chalk, or white show-card color paint before applying the design. This will produce a more visible line.

3. *Cutting or engraving the block:* The parts of the design which are to print are left in the relief and the rest is cut away. To avoid confusion, be sure to mark the certain parts in pencil that are to remain on the block.

The first step in engraving is outlining the design, keeping as close to the line as possible without cutting into the face of the design. Carve slowly, holding the smallest veining tool at a 45-deg. angle in order to increase the strength and durability of the relief. After completing the outline, gouge out the remaining areas, or nonprinting portions close to the burlap. This will prevent any "high spots" from showing on the paper. Always cut away from the lines of the design instead of toward them. Be sure never to cut under the edges of the printing surface as the edges are likely to break under pressure of the printing. Work carefully as any little slip will show in the print. See Figure 2.

Speedball linoleum cutters have proved very satisfactory. Figure 3 shows cross-

Fig. 2. Cross sectional view of how to cut linoleum blocks

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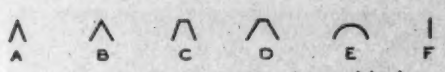

Fig. 3. Contours of linoleum block cutters

section outlines of the various cutters to be used. At *A* is shown the cutter to be used for thin white lines. The one at *B* is used for touching up rough, irregular edges and also to obtain depth. The cutter at *C* is used for heavy white lines. Those shown at *D* and *E* are used for gouging out large nonprinting areas, and the one shown at *F* is a knife which may be used for trimming, cutting straight edges, or for obtaining a stipple or dotted effect on the design.

Linoleum Block Holder

This holder is a very handy instrument for supporting the mounted or unmounted linoleum blocks while they are being cut. A hook on the lower part is made to fit up against the edge of a table. The walls are securely fastened with screws. They are placed at right angles to each other and project about ¾ in. above the base. This easily made holder is sketched in Figure 4.

The block holder also serves as an important safety measure in preventing cut fingers and hands. While one hand holds the cutting tool, the other hand may be used to direct it along the proper lines of the design. It will thus keep the free hand from the necessity of holding the block in place and also keep it from getting in the way of the hand holding the tool.

Before the block is to be printed on the press, a proof should be taken. This proof enables one to make corrections, smooth up rugged edges, and remove any "high spots" that are not supposed to print. The block is then ready for printing.

4. *Inking and Printing:* In order to print the block, the first step is to ink it. This may be done in any number of different ways. Special inks, water colors, or ordinary printer's oil inks may be used. These inks may be purchased from a local

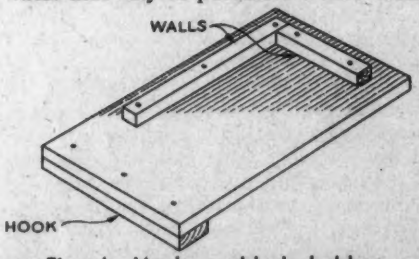

Fig. 4. Linoleum block holder.

printer's ink supply company or any concern that sells architectural and office supplies. All colors may be had in quarter-pound tubes. A small quantity of ink is placed on a glass, marble, or steel slab, and it is then spread with a printer's "brayer." Next, roll the inked brayer over the linoleum block, but be careful not to spread the ink on too heavily, lest it squeeze out while printing, and give a ragged edge to the lines. A test for a good print is an even tone of color throughout the entire block.

There are many different types of presses which may be used to print the block. Small hand lever presses may be purchased from $2.50 up. For hand printing, where a regular power printing press is not available, a bookbinder's press has proved to produce the best results. A good print depends upon the proper pressure. It is a matter of experience to obtain the best prints, therefore, do not become discouraged if the first prints do not prove satisfactory.

NOTE: To prevent smudging of the prints as they are made, spread them out singly in a place where they will not be disturbed, or else "slip-sheet" the prints, that is, separate them with clean, newsprint paper. The prints should be thoroughly dried before being handled.

If a motor-driven platen press is available, a different procedure for printing the blocks is necessary. The press is inked first. The block is next locked up in a cast-iron frame called a *chase*, and then the entire form is placed into the press. Cover the platen with a sheet of strong manila tympan paper. Have the packing fairly hard. Before making an impression on the tympan, make sure the "grippers" or iron fingers that hold the sheet of paper in place, are out of range of the block. Impression can be regulated by adding or removing extra sheets in the packing. If the block is uneven, pieces of paper may be added to the back of it. This process of *make-ready* or making the *form* (linoleum block in this case) print with an even impression on paper, requires personal judgment and experience. The guides are next set and the actual printing is then begun.

5. *Mounting or displaying prints:* Good prints should be properly mounted and exhibited. Mount the prints on heavy cover or display stock. Use stock that will harmonize in color and shape with the block. A contrast in black and white is always very effective.

Fig. 5. Two-color linoleum block

The top and side margins of the mount should be equal with a larger margin at the bottom. Some prints may be framed with clear glass, with or without margins, depending on the nature of the design and subject of the block.

Block Printing in Color

It is necessary to have a separate block for each color to be used in the design. The block containing the outline of the masses should be used as a key, and the others must be registered with it, both in the transferring and in the printing.

The complete design must be made on tracing paper first. Obtain enough blocks to represent each color. Be sure that each block is the same size as this will aid in transferring and registering one color upon the other. Review the procedure for applying the tracing upon the block and then cut each one. To avoid confusion, be sure to mark your tracing in some way, indicating the different colors. Remember that each color is traced individually upon separate blocks. The key block should be cut and proofed first. Touch it up if necessary. Pull another proof and then match it with the complete or master tracing. When the key block is satisfactory, proceed to trace and cut the other blocks.

Another method would be to trace the complete design on one block. Cut it out carefully and pull a number of proofs on thin tracing paper. While the ink is still wet, place it face down on each of the other blocks and apply pressure carefully with fingers. This will leave an exact impression on each block. Permit the ink to dry and then mark the various parts of the design for each color. Proceed to cut the blocks in the usual way. Pull proofs and match them with the master design. Assemble the individual proofs and hold them up to a strong light. Make any necessary corrections. If everything is in order, proceed to cut away the areas of the key block that are to be in color, leaving the outline for the black ink. See Figure 5 for sample of two-color linoleum block.

For block printing, best results are obtained with soft, antique finished paper. Avoid hard, glossy paper. Colored papers may be used as part of the picture and design. A real pleasure may be had from seeing the same subject appear in different colors. A large assortment of samples can be gotten from paper companies in your locality.

Outline of Operations and Summary

The procedure involved in preparing and printing a linoleum block is briefly summarized in the following steps:

1. Study the unit, reference books, and samples carefully before attempting to make a linoleum block.
2. Draw a simple design on a piece of white paper.
3. Make a complete tracing on thin tracing paper.
4. Secure all the tools and materials necessary to produce your block.
5. Surface the linoleum with either a thin coat of white chalk or white show-card color.

6. Place the carbon paper face down upon the linoleum block.

7. Next, place the tracing face down upon the carbon and thumbtack it down. (NOTE: Be sure the thumbtacks are outside the drawing or in a spot inside the drawing that will be cut out of the block.)

8. Use a hard lead pencil to trace the outline of the design on the linoleum with enough pressure to effect a transfer.

9. Using the linoleum block holder, outline the design with the smallest veining tool.

10. Gouge out the remaining areas, or non-printing portions close to the burlap. (NOTE: Work carefully, as any little slip will show in the print. Cut away from the line instead of toward it.)

11. Pull a proof and smooth any unnecessary ragged edges. Also remove any "high spots."

12. Pull another proof on thin tissue or tracing paper and match it with the master or complete tracing.

13. Repeat the cutting operations on other blocks, if more than one color is used. Pull proofs and match with master tracing.

14. Lock up the block in a chase and get it ready for the press.

15. Cut the paper stock to size.

16. Ink up the press and then place the form in it.

17. Adjust the grippers and change the tympan sheet.

18. Pull a proof on the tympan or draw sheet.

19. Set the guides and regulate the impression.

20. Have the instructor check your work carefully before proceeding to "run off" the job.

21. Spread the prints out on a shelf of the drying rack.

22. When they are dry, gather them and mount them.

The process of printing linoleum blocks provides an excellent pedagogy for the secondary-school graphic-arts laboratory. It provides a variety of means for course enrichment and student self-exploration as well as for group participation.

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Woodworking for the Slow-Learning Child

*Louis L. DeGiacomo**

The slow-learning children, particularly those in the so-called retarded classes, present a scholastic problem because they usually lack good judgment and common sense, and often fail to display sufficient resourcefulness, reasoning, initiative, and insight. However, with these obvious shortages much can be accomplished in developing them to the full extent of their capacity if purposeful and planned handwork is given. Too often the handwork given lacks purpose, except that it is a time-killing device. Since woodworking is the most common form of handwork used for this problem boy, whether it be done on the one bench in the back of the room, or in a regular woodworking class, let us consider woodworking as a subject of discussion.

It is usually unanimously agreed that the slow-learning child needs handwork, still, when the period of woodworking comes in the program it is usually carried on as a period of punishment for the teacher, and a period of unintelligent sawing and shaving-making for the boy. There is no need of this, and the blame usually is due to the fact that the teacher, who will go to no limits in studying and preparing for the other subjects, will give little thought in preparing herself for this. Too often woodworking is done aimlessly, and other than providing a simple pattern to be traced on plywood, cut with a coping saw, and then painted, little else is done. When the child, who frequently remains in the same room or shop for a second term, complains that he is making "baby stuff," then the teacher vainly attempts to have the pupil make an object which requires more than one piece, which usually has a tragic ending.

In an effort to overcome this injustice to the child and to the teacher, woodworking as a subject will be discussed.

Aim: The aims of woodworking are many. It may be to use up excess energy, or establish habits of cleanliness, or for exploratory purposes, but if purposeful woodworking is to be taught, the aim should be to teach the basic fundamental processes and a knowledge of tools and materials related to the subject.

The fundamental processes are given first consideration because they are as essential to the proper study of woodworking as phonics is to reading, or the number concept is to arithmetic. Without this basic foundation woodworking remains limited to the coping saw level.

It is vital that a knowledge of the common tools be given the child, because without this the fundamental processes cannot be truly employed.

A knowledge of the materials supplements both processes and tools, because only in that way is the unit completed.

Considering the fundamental processes, the basic minimum requirements are the six rules or steps used to square a piece of wood to a desired thickness, width, and length. This order must be maintained because the squaring-up processes demand that the desired thickness be obtained first, then the width, and lastly, the length.

These six rules should be stressed repeatedly by all means and devices that the teacher can employ, until they are firmly fixed in the child's mind, so that he can do them on a piece of wood with as great a facility as sounding his basic phonetics or adding single digits. When this is completely established, then the second phase may be attempted, and this is modifying the pieces and assembling them by simple means so that they become projects.

This is best explained by the example of a bookcase or any other project which is made up of several squared pieces of wood. Your observations will disclose that the bookcase is primarily composed of boards of specified thicknesses, widths, and lengths, assembled to form a whole. It is true that the average bookcase may involve difficult joints, but one purposely planned to be assembled by cleats will be just as strong and effective.

The six rules as illustrated by the drawings are not easily grasped by the child, and since the stress is upon them, he will have to perform these functions many times before they become fixed. This repetition should not be attempted on one project of many parts, but upon one project of one piece. These projects should be simple, attractive, purposeful, and should maintain the interest of the child throughout. Example: a knife strap, simple marble games, a checkerboard, plaques, etc.

Lectures are of little use, and lesson plans and job sheets are of little or no value because many of the pupils are unable to read, and those that can are not able to translate the printed material into the activity.

The teacher must rely on demonstra-

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tions, and on self-explanatory pictures, and models aided by pupil participation. Each effort should be unstintedly praised to give self-confidence. In demonstrating, the child sees the action performed before him and contributes by asking and answering questions, and actually performing the process to prove to the others that it is not beyond their doing. Every teacher should have either on the blackboard or on large cards about the room, the illustrations of the six progressing steps "to square up a piece of stock," because after the boy has performed these a sufficient number of times, he will be able to do this himself by just using the illustrations as a reference. Only when this is accomplished, may the boy advance to the more difficult and modifying processes.

Tools: Teaching the knowledge of tools is not a separate study, but one which is closely tied with the study of the processes. The tools are taught as the boy is ready to use them. He should be able to identify them by name, understand their care, know how to handle them as well as how to hold them, and he should know something about their maintenance. All safety precautions should be stressed continually.

As the child uses a tool, he should be made conscious of its name and how the name is spelled. This may be done by placing the name close to the illustration of the tool in the six drawings of the processes. This will not only teach him the spelling, but will associate the name with the tool. When he refers to the tool as "that tool" or "it," the name of the tool should be mentioned by the teacher. Then the boy should be asked to repeat it, without making him too conscious of that fact.

Materials: Learning something about materials is not only essential for the successful understanding of the subject, but it can be made a most interesting phase of the work, because it contains elements of wonderment, surprise, and mystery. It is also an excellent means of motivation for the academic subjects because it provides a purposeful starting point. As the child uses the different materials he should be informed as to how it is manufactured, from what countries it is obtained, and something about its cost. This should all be done by putting it in the form of an interesting story.

Projects: The project is a good one only when it meets the ability of the child, has sufficient appeal, and usefulness.

The first projects should be simple ones involving the six fundamental processes and a few other essential ones, to complete the job. They should require but a brief period of time to complete, because they are the means of learning. Many short projects should be used in preference to one lengthy one. After the child has proved his ability he can be given individual work which has been simplified in construction and still maintains a professional appearance.

The teacher should prepare and simplify the projects in dimensions, in construction, and prevent the "made in a classroom" appearance. Careful analysis and study on the part of the teacher will prove that most projects can be constructed simply, and still maintain their strength.

Since seeing and feeling are the two senses most used by this child, it is imperative that the child has either a model or the actual thing to go by. Models are most convenient because of their size, and because they have a magnetic power of appeal. If the child should through his own initiative develop an object himself, he should be asked to make a model for others to refer to and add to the collection. This is very willingly done, because it is good and appeals to the child's ego.

A drawing of the simple parts of the object will supplement the model, and provide the necessary dimensions that the child needs.

Lists of Processes

This is a list of the various processes in the order of their necessity in developing essential skills. They are the simple and primary processes and are developed from the list of tools listed as minimum requirements.

First List

1. *Using the vise:* Placing stock in vise. How to care for and use this holding tool intelligently.
2. *Crosscut and ripsawing:* The identification and characteristics of each saw. Conditions under which each is used. Starting the saw. Holding the saw. Safety precautions.
3. *Planing with jack plane:* Positions of right and left hands. The direction of movement on the piece. The pressure applied to keep the plane flat upon the work. Reason for laying plane on its side. Adjustment and care of plane.
4. *Measuring with rule:* Rule, an instrument of measuring. Position in which rule is held to measure.
5. *Squaring with the try square:* The names of the parts of the try square. The care of the try square. Position of the hand for grip. Finding the concave side of a board. Testing a planed surface. Scoring ends.
6. *Using the scoring knife:* Sharpening the point. Holding the knife to score and scarf. Safety precautions.
7. *Backsawing:* The proper position of the hand on the grip. Position of saw on work. Method of stroke. Safety precautions.
8. *Using bench hook:* Holding piece while scoring, gauging, and backsawing.
9. *Sawing curves with coping or turning saw:* Position of hands on saw. Length of stroke. Speed of saw and its position in relation to work.
10. *Filing:* Holding the file. Direction of stroke. Use on curved surfaces only. Cleaning file with file card.
11. *Nailing parts together:* Strokes of hammer. Holding hammer. Selection of brads. The manufacturing of brads. Spacing brads. Related knowledge (measured, types, sizes, etc.). Gluing surfaces. Drawing brads from wood.
12. *Setting brads with nail set:* Selecting set with desired point. Placing set on brad. Amount brad is depressed.
13. *Sanding surfaces:* Selecting grade of sandpaper. Method used on flat and curved surfaces. Understanding the uses of coarse and fine sandpaper. Related knowledge (types, grades, manufacture, sizes, etc.).
14. *Waxing:* Applying, and polishing. Related knowledge (manufacture, kinds, grades, etc.). Care of cloths in polishing.
15. *Painting:* Applying coat. Selection of brush and care. Conditions conducive to best results. Thinning paint. Selection of colors. Cleaning brush and paint can. Related knowledge of paint and brush.
16. *Simple oil staining:* Related knowledge about linseed oil. Applying the oil. Rubbing the oiled surfaces. Safety precautions of cloth.
17. *Varnishing:* Related knowledge about varnish. Selection of brush. Applying. Room conditions. Drying.

Second List

1. *Gauging:* Knowing the parts of the gauge. Adjusting gauge to desired measure. Placing the gauge in hand. Gauging the line on both sides of piece.
2. *Using the bit brace:* Setting the ratchet. Placing bit in chuck of brace. Method of holding and turning the brace. Variety of positions used for different types of boring.
3. *Boring with auger bit:* Identifying the bit. Significance of the number as related to its side. The names of the parts and their function. Boring until spur point appears and counterboring. Care of bit.
4. *Boring with gimlet bit for screws:* Identifying the bit and how it differs from the auger bit. How size is determined. Reason for boring directly through. Care of and sharpening bit.
5. *Countersinking for screws:* Determining depth to countersink. Setting countersink in bit brace.
6. *Using screwdriver of screwdriver bit:* Selecting proper screwdriver to fit screw. Selection of proper screws. How screws are measured. Different types of screws. Gluing screwed surfaces. Related knowledge (manufacture, styles, wire, color, etc.).

Third List

1. *Using the spoke shave:* Adjustment of blade. Advantages over file. How held in hands. Following grain in working curves.
2. *Using the block plane:* Characteristics of plane. Special uses of plane and reason. Reason for use on specific work.
3. *Using the smoothing plane:* Characteristics of plane. Shape of blade. Uses and advantages.
4. *Drawing curves with compasses:* Setting the compasses to desired sizes. Names and parts of circle (radius, diameter, circumference). Drawing parts of curves.
5. *Scraping surfaces:* Proper condition of edge for good work. When use of scraper is advisable. How used.
6. *Using chisels and gouges:* Names and characteristics of common chisels and gouges. Care in use. Position of chisel when in use. Why mallet is used in driving chisels and gouges. Safety precautions.
7. *Using depth gauge:* Applying gauge to bit. Reason for use. Measuring to desired depth.
8. *Clamping pieces together:* Different styles and sizes of clamps and handscrews. Adjustment of clamps and handscrews. Placing clamps on work. Protection for work from pressure of clamps.
9. *Cutting with miter box:* Placing stock in miter box. Adjustment for different angles. Cutting square ends and miters. Advantages of miter box.

10. *Finishing:*
    a) Stains: How to mix and use the materials. How to apply. Wiping the surface. Care of cloth.
    b) *Fillers:* Reason for filling. Mixing with colored stain. Applying filler. Rubbing off across the grain. Drying the filler. Care of the cloth.
    c) *Shellac:* Manufacture of shellac. Different types of shellac. Characteristics. Applying shellac. Rubbing down with sandpaper, steel wool, pumice and oil.
11. *Simple joints:*
    a) *Butt joint.*
    b) *Screws and nails.*
    c) Cleats.
    d) *Dowel joint.* Laying out joint. Fitting the pieces. Applying glue and clamping. Selection of best joint for work.

Lists of Tools

Tools that the boy should be able to identify by name, and know how to use for the fundamental working processes.

In the first list are the tools used to fulfill the minimum requirements of squaring a piece of stock to the correct length, width, and thickness, and other simple tools used to modify the shape into simple designs.

The second list adds to the first, in that it goes further into the processes as the pupil advances. A thorough knowledge of the first is essential before the tools in the second list are used.

The third list includes the tools that are needed for the more advanced processes and are only for those students who have a true understanding of how to use the tools in the first two lists.

First List

1. Vise
2. Crosscut saw
3. Ripsaw
4. Jack plane
5. Rule
6. Try square
7. Scoring knife
8. Backsaw
9. Bench hook
10. Coping saw
11. Turning saw
12. File
13. Hammer
14. Nail set

Second List

1. Marking gauge
2. Bit brace
3. Auger bit
4. Gimlet bit
5. Countersink
6. Screwdriver bit
7. Screwdriver
8. Spokeshave
9. Block plane
10. Smooth plane

Third List

1. Compasses
2. Scrapers
3. Chisels
4. Mallet
5. Gouges
6. Depth gauge
7. Clamps
8. Miter box

List of Materials

Materials that the boy should be able to identify by name and know their fundamental uses in the various processes.

Many of the materials mentioned in the list begin with "Knowledge related to its manufacture." This is given priority because it is a means to a better understanding in the use of the materials as well as establishing points of interest. The history and geography of the material provides many means of correlation with the academic subjects, and leads to a greater respect for the material.

First List

1. *Wood:* The wood used by the boy should be a soft clear wood, easily worked, straight grained, and one that takes the various stains easily. White wood and basswood meet these requirements. When the boy has advanced sufficiently, he may make his larger projects in mahogany, or other hardwoods, so that his work may have more of the professional characteristics.
2. *Brads:* Knowledge related to the manufacture of brads. The various sizes and shapes. The special uses for each size.
3. *Nails:* Knowledge related to the manufacture of nails. The various sizes and shapes. Special uses for each size. How brads differ from nails.
4. *Glue:* Knowledge related to the manufacture of glue. Characteristics of hot and cold glue. Conditions in which each is used.
5. *Varnish:* Knowledge related to the manufacture of varnish. Properties of varnish. Drying qualities. Conditions for applying varnish.
6. *Wax:* Knowledge related to the manufacture of wax. How applied. How polished. Qualities and advantages.
7. *Paint:* Knowledge related to the manufacture of paint. Selection of colors. Applying. Drying. Thinning.
8. *Brushes:* Knowledge related to the manufacture of brushes. Selecting brush suited for job. Cleaning and drying brushes.
9. *Sandpaper:* Knowledge related to the manufacture of sandpaper. Various kinds used on wood. How sandpaper is graded. Type to use under different conditions.
10. *Wiping cloth:* Economy in use of piece. Care of oily cloth. Washing.

Second List

1. *Waste:* Knowledge related to the manufacture of waste. When used to best advantages. Care of oily waste.
2. *Linseed oil:* Knowledge related to the manufacture of linseed oil. Use in paint. Use as a finish in stain. Safety precautions against fire. Storing in cans.
3. *Kerosene, oil:* Knowledge related to the manufacture of kerosene oil. Use as a cleaner. Safety precautions. Storing in cans.
4. *Turpentine:* Knowledge related to the manufacture of turpentine. Used as a thinner. Use in stains. Drying agent. Safety precautions. Storing in cans.

Third List

1. *Stain:* How stains are mixed by boy. Knowledge related to manufacture of stains. How various colors are obtained (umber, sienna, etc.). Drying qualities. Dangers to work. Safety precautions of stain and cloths used. Purpose of stain.
2. *Filler:* How to mix filler. Variety of fillers and selecting best suited. Drying qualities. Purpose of applying filler.
3. *Shellac:* Where shellac is obtained. Preparing shellac with alcohol. Thinning. Drying qualities. Advantages of shellac.
4. *Alcohol:* Its use with certain type stains. Knowledge related to its manufacture. A thinner for shellac. Quick-drying qualities.
5. *Steel wool:* Use as a finishing material. Advantages in its use. Method of grading.
6. *Pumice stone:* Knowledge related to its manufacture. Its many uses. As a finishing abrasive.
7. *Dowels:* How they are made. Type of wood used. The variety of sizes and types.
8. *Rubbing oil:* How it differs from linseed oil. Its use as a finisher. Rubbing the surface with the oil. Care in using. Safety precautions. Storing.

Essentials of an Instructional Plan

*Lt. Comdr. J. W. Giachino**

Any technical training program, regardless of its type, level, or scope must be predicated upon a well-defined instructional plan if it is to function efficiently and effectively. Without such a plan, instruction probably will be disorganized and wander in a haphazard, uneconomical, and unproductive manner. Operating a training program on the basis of a clear-cut plan definitely will guide instruction, keep it within its prescribed limits, insure its continuous movement in the right direction, and produce the desired end result.

The various naval air technical-training programs established to provide qualified personnel for the aeronautical organizations, ashore and afloat, during the past emergency period, as well as for the post-war era, were and are being conducted on an instructional plan consisting of the following seven components: (1) course of study, (2) lesson plans, (3) instructional aids, (4) testing program, (5) uniform grading system, (6) training schedule, (7) graduation standards.

Course of Study

A course of study, as conceived for naval air technical training, is a comprehensive plan showing in detail the scope and proper teaching sequence of all practical work jobs and related information. The course of study is regarded as the master blueprint of training and it serves as a guide and check for the administrative, supervisory, and instructor personnel to insure complete coverage of instruction as required for a particular field of training. The basis of any course of study is the trade analysis, which is a methodical process of indicating specifically what is to be taught in a particular training course. By means of a trade analysis, the material designated for training is selected,

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screened, and arranged into a logical teaching order.

All naval air technical-training courses of study are designed to have a uniform format, and contain the following information:

1. *Length of course.* The length of the course is specified in weeks, days, or hours, and definitely sets the actual period of instruction.

2. *Objectives of the course.* The objectives are specific and concise statements indicating the actual purpose of the course. These objectives are stated to show the nature of the skills and knowledge to be acquired by the trainees.

3. *Qualifications of trainees eligible for training.* Inasmuch as the course of study is designed to train men for a specific purpose, the course of study is required to indicate the qualifications which trainees must possess to be eligible for training.

4. *The main divisions (phases) of the course with time span for coverage.* These divisions or phases consist of practical skills and knowledge characteristic of a particular branch or area of training. For example, Class *A* aviation metalsmith training is divided into the following divisions:

I Basic	2 weeks
II Sheet Metal	9 weeks
III Welding	4 weeks
IV Fabric	2 days
V Fuel Cells	4 days
VI Flight Controls	1 week
VII Aircraft Assembly	1 week
VIII Squadron Operation	3 weeks

5. *The outline of the material to be covered for each division of training.* This material is broken down into units (blocks) and lessons arranged in a definite teaching sequence. A *unit* consists of a series of closely related work jobs and information topics. Each unit is further divided into *lessons*. A lesson deals with instructional material that can be conveniently covered during a specified period of time. In most instances, a lesson will cover one specific job and its related information. The time necessary to complete the lesson is always indicated.

The body of the course of study is arranged to show the outline of the related information in one column and the practical work job in another. The related information is closely allied with the work job. Thus, if the right-hand column indicates a practical work job, such as removing spark plugs, the material in the left-hand column opposite the work job shows the related information applicable to removing spark plugs (see sample page of course of study).

In many instances, the course of study includes more than one work job for a particular lesson. Listing of several jobs is done to permit best possible use of the available equipment, and to compensate for individual trainee abilities.

6. *Instructional aids.* Each lesson of the course of study includes instructional aids in the form of mock-ups, charts, films, information sheets, and job plans, which are to be used to assist in covering the material prescribed for the lesson.

Sample Page from a Course of Study

PHASE II — SHEETMETAL

Unit 18 — Hand Riveting — 12 hours

Practical Work	*Related Information*
Lesson No. 46 — Driving Rivets by Hand — 6 Hours	
Job No. 51 — Practice hand riveting (drive AN430 rivets in double thickness of metal)	1. Rivet sizes
Job No. 51A — Practice hand riveting on wing or fuselage section	2. Selecting correct size rivet *a*) Diameter *b*) Length *c*) Composition
Job No. 51B — Hand rivet a sheet-metal container	3. Rivet spacing *a*) Maximum *b*) Minimum *c*) Edge distance
	4. Drill size
	5. Buck tail size *a*) Correct size of bucked head
Instructional Aids a. Job Plan No. 51 — "Hand Riveting" b. F4U Wing c. F4U Fuselage	*Instructional Aids* *a*) Information Sheet No. 46, "Hand Riveting" *b*) Charts showing size of rivets
Lesson No. 47 — Removing Rivets — 3 Hours	
Job No. 52 — Removing rivets from Job No. 51	1. Inspecting rivets *a*) Points to look for *b*) Devices for checking
Instructional Aids *a*) Job Plan No. 52, "Removing Rivets"	2. Removing rivets *a*) Poor rivets *b*) Causes for poor rivets *c*) Tools for removing rivets *Instructional Aids* *a*) Information Sheet No. 47, "Rivet Inspection" *b*) Film SN–126, "Removing Rivets" *c*) Technical Order 93–42

Lesson Plans

A lesson plan is a detailed outline used by the instructor as a guide in presenting a lesson. The lesson plan tells the instructor just how he is to teach, thereby insuring that instruction is presented to the students in a logical learning sequence. Lesson plans also serve to produce uniformity when the same units of work are being taught by several different instructors.

One lesson plan is used to cover both related information and practical shop work, even though the related information may be taught by a classroom instructor and the practical work by a shop instructor. The use of a single lesson plan produces close co-ordination between classroom study and shopwork (see sample lesson plan No. 46 shown below).

The lesson plans used by naval air technical-training activities include the following elements: (1) title, (2) objective, (3) time, (4) instructional aids, (5) instructor's references, (6) teaching procedures (motivation, presentation steps, checking for understanding, summarization), (7) student application.

Sample Lesson Plan

LESSON PLAN NO. 46

Phase II Sheetmetal — Unit 18 Hand Riveting

Date:

I. *Title:* Driving rivets by hand

II. *Objective:* To learn the correct procedure and develop the ability to rivet two pieces of sheet metal together by hand

III. *Total Time:* 6 hours

CLASSROOM — RELATED INFORMATION — 1 Hour

IV. *Instructional Aids:*

1. Information Sheet No. 46, "Hand Riveting"
2. Charts showing rivet sizes
3. Samples of rivets
4. Samples of rivet jobs showing correct and incorrect riveting
5. Chart showing correct spacing
6. Chart illustrating proper buck tail
7. Chart "Drill Sizes for Rivets"

V. *Instructor's References:*

1. Information Units 11 and 12, Aviation Metalsmith Manual

VI. *Teaching Procedure:*

A. *Motivation*

1. Why is it necessary to learn to drive rivets by hand?
2. Review rivet designation of previous lesson using chart.

3. What are the important things to consider in a good rivet job?
   a) Proper rivet — composition, diameter, length
   b) Correct spacing
   c) Buck tail

B. *Presentation Steps*

1. Selecting the rivet
   a) Composition — depends upon two factors
      (1) Material being fabricated — rivets should not be harder than material
      (2) Stress — use soft rivets when shear stress is low — hard rivets for high stress
      (3) Show poor job resulting from using too hard a rivet
   b) Diameter
      (1) Maximum — 2½ — 3 times thickness of the thickest section
      (2) Minimum — not less than thickness of thickest section
      (3) Show poor job resulting from use of rivets too large in diameter
   c) Length
      (1) Thickness of metal plus 1½ times the diameter of the rivet
   d) *Check for understanding*
      (1) What three things determine the selection of the proper rivet?
      (2) Discuss each
2. Drill Size
   a) Correct size — approximately .002 to .004 in. larger than the rivet diameter
   b) Using chart illustrate proper drill size for commonly used rivets
   c) Too small — buckling metal or grooving shanks
   d) Too large — bending shanks
   e) *Check for understanding*
3. Spacing Rivets
   a) Maximum — 24 times thickness of thinnest sheet
   b) Minimum — 3 times rivet diameter
   c) Edge distance — at least two times diameter for regular head rivets — 2½ times diameter for countersunk rivets
   d) Illustrate with chart, "Rivet Spacing"
   e) *Check for understanding*
      (1) Determine maximum and minimum spacing and minimum edge distance for the following riveting jobs:
         (a) Two sheets of .040 aluminum using AN430AD-2-3 rivets
         (b) Two sheets of .040 aluminum using AN456AD-3-4 rivets
      (2) Determine drill size to use for the following rivets: *Code number;* AN430AD-4-5; AN442A-3-4; AN430D-6-8
4. Bucked tail
   a) Height — one-half diameter of rivet
   b) Diameter — 1½ times diameter of rivet

C. *Summarization*

1. Selecting the rivet
2. Drill size
3. Rivet spacing
4. Bucked tail

SHOP DEMONSTRATION AND PRACTICE — 5 Hours

IV. *Instructional Aids*
1. Sample of completed job
2. Sheet metal ready for drilling
3. Bucking bar
4. Ball-peen hammer
5. Center punch
6. Drill and drill press
7. Job Plan No. 51
8. Supply of proper size rivets

V. *References*
1. Information Units 11 and 12, Aviation Metalsmith Manual

VI. *Teaching Procedure:*

A. *Motivation*

1. Tie up with classroom related information explaining what they have learned
   a) What factors determine the proper rivet to use
   b) How to determine the proper size drill
   c) How to determine spacing of rivets
   d) The proper type of bucked tail.

B. *Demonstration Steps*

1. Make layout
   a) Determine edge spacing
   b) Determine spacing of rivets
2. Center-punch holes
3. Drill holes
   a) Determine proper drill
4. Remove burrs
   a) Reason for removing
   b) Methods of removing
5. Insert rivet and buck
   a) Selection of correct bucking bar
   b) Stress proper method of striking
6. Check bucked tail
   a) Dimensions of bucked tail
7. Repeat 5 and 6 several times stressing:
   a) Proper method of striking
   b) Correct bucked tail
8. Have a few students drive rivets

C. *Summarization*

1. Steps in hand riveting
   a) Laying out
   b) Center punching
   c) Drilling holes
   d) Removing burrs
   e) Inserting and bucking rivet
   f) Checking bucked tail

VII. *Student Application*
1. Distribute Job Plan No. 51
2. Assign students to benches and have them practice hand riveting

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Instructional Aids

Instructional aids are devices designed to facilitate teaching and learning and to shorten the learning period. The term instructional aids as used here includes the following:

1. *Instructional material* — (*a*) information sheets; (*b*) job plans; (*c*) technical manuals; (*d*) navy training course manuals; (*e*) BuAer and BuOrd publications; (*f*) technical notes and orders.

2. *Visual aids*—(*a*) mock-up; (*b*) models; (*c*) charts, diagrams and posters; (*d*) cutaways; (*e*) blueprints; (*f*) films.

Information sheets. An information sheet is a sheet containing the necessary related information for a specific job. It serves as the trainee's guide in learning the important technical knowledge for the practical work job that is to be done in the shop.

Manuals, course books, technical notes and orders, and other BuAer and BuOrd publications are frequently used in place of or as supplements to the information sheets. As a matter of practice, if individual information sheets are prepared, the essential material in the afore-mentioned publications is usually incorporated in the body of the information sheet.

Job plans. A job plan is the trainee's guide for carrying out the work job specified by the lesson plan. It shows, in proper order, the major steps involved in the performance of the job. A job plan indicates the tools and materials that are to be used and contains a blueprint, sketch, or illustration of the job to be done.

Testing Program

This essential component of testing is concerned with determining, first, how well and to what extent the knowledge and skills laid down by the course of study are being achieved and, second, the effectiveness of instruction.

Two major types of tests are used in naval air technical-training activities — paper objective tests and practical performance tests. The paper test finds its greatest usefulness and value in the measurement of knowledge, whereas the practical performance test is designed to measure "ability to do" by checking the skills attained while a given job or operation is being performed. Because the work of NATechTraCom activities calls primarily for the acquisition of skills, the performance type of test is used much more extensively than the paper type.

Objective paper tests are generally limited to the following types: (1) true and false; (2) multiple choice; (3) matching; (4) completion; and (5) identification.

Uniform Grading System

A grading system is established: (1) to indicate an individual's degree of accomplishment, and (2) to arrive at grades which represent relative standings in a training program and which may be used for evaluating any part of training.

Composite individual grades are derived from the following three elements, each of which is assigned a percentage value: (1) work-job grades; (2) paper-test scores; (3) practical-test grades.

To bring about a high degree of objectivity and to insure uniformity in the grading of work jobs and practical tests, uniform standards (grading scales) are established.

To produce the greatest possible degree of objectivity in the grading system, each division of training is weighted in relation to all others and assigned a definite percentage value. The elements constituting a grade are in turn apportioned in accordance with the established values of the divisions.

Training Schedule

A training schedule is a plan indicating when, where, and by whom each lesson is to be taught. Such a schedule shows the place, the week, the day, and the hour instruction is to be given.

The function of a training schedule is to produce a smooth running organization and to insure that instruction is being covered as prescribed by the course of study (see sample schedule).

Graduation Standards

Graduation standards are established for a training activity to assure that graduating trainees are fully qualified and capable to perform the work for which they have been trained. The standards are in the nature of specific skills which trainees must have acquired, and the degree of proficiency with which they must execute the required skills. In addition, graduation standards indicate the level of attainment by trainees of the essential related knowledge.

SAMPLE TRAINING SCHEDULE
AVIATION ENGINEERING OFFICERS' SCHOOL
PHASE I — STRUCTURES
1st Week

Classroom *Day*	*Time*	*Room No.*	*Lesson*	*Shop Time*	*Room No.*	*Job*
1	0800 to 0950	106	No. 1 Airplane structures	1000 to 1200 1300 to 1500	2	No. 1 Remove and install wing panel — F6F
2	0800 to 0950	106	No. 2 Rigging	1000 to 1200 1300 to 1500	2	No. 2 Rig ailerons on F6F No. 3 Rig elevators on F6F No. 4 Rig rudder on F6F
3	0800 to 0950	106	No. 3 Plexiglas	1000 to 1200 1300 to 1500	2	No. 5 Clean Plexiglas No. 6 Repair crack in Plexiglas

GRADUATION STANDARDS FOR AVIATION RADIOMEN

Practical Factors

Skills	*Degree of Proficiency*
1. Send and receive aircraft code and plain language messages	20 words per minute
2. Communicate by means of hand rhythm sending	8 words per minute
3. Blinker	10 words per minute

Written Factors

Subjects	*Grade*
1. Recognition	85 per cent
2. Watch Standing	62.5 per cent
3. Operational Theory	62.5 per cent

Radio Communication Training In High School

*James Perkins Saunders**

The reconversion of education to a peacetime basis requires more than a sweeping elimination of preinduction courses and a return to prewar studies. It should include a critical evaluation of the work done during the war years to ascertain what may be of permanent value. Also included should be a careful study of postwar requirements. As a result it will be found that much of the preinduction work filled a real long-time need. Some effort to retain these features in postwar education should be made. Likewise, an attempt to envision the world of the future in which our boys and girls are to live will reveal that new emphasis must be made in certain fields, especially in vocational and avocational skills and in guidance.

Total victory was achieved through the combined efforts of *all*, including our armed forces and the home front. However, this victory was due, in no small part, to the superior communication systems set up by our armed forces. World War II was fought under situations which were different from any we had ever faced before. Individual groups carried the battle to the enemy by land, sea, and air. Co-ordination was necessary for success. This co-ordination was achieved by *communication*.

To supply the unbelievable numbers of radio operators, technicians, and signal men required to carry on these communication services, our government drew upon the thousands of self-trained amateur radio operators. To supplement these men the armed services established many fine schools for training purposes. The high schools of the nation also responded to the request of the War Department by introducing P.I.T. courses to give their students the basic training so essential for success in the armed services.

But — what shall we do with these fine P.I.T. courses? Especially, what about those that give the student a training which will prove of value in peace as well as in war—in the future as in the past? Those who should know are agreed that the future of radio and electronics hold great promise. If so should not our secondary schools be ready to give students the necessary training?

The surface of the possibilities of radio and electronics has hardly been scratched. The coming of frequency modulation, television, and the peacetime applications of radar, not to mention the almost unlimited possibilities of electronic control in industry, points the way to an ever expanding future. Add to this the absorbing hobby of amateur radio indulged in by some 60,000 prewar "Hams," with a prophecy

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of some 250,000 amateurs in the coming postwar years, and you have a most convincing array of arguments for the introduction of radio communication training in *all* our high schools as a regular part of the curriculum.

This article describes a successful training program which is being carried on at the Northbridge senior and junior high schools, Whitinsville, Mass. The program has been in operation since September, 1942, during the war as a P.I.T. course and now as P.W.T. (postwar training). The combined enrollment of both the junior and senior high schools is approximately 800 and includes grades 7–12. What has been accomplished in this medium-sized high school can be duplicated in *any* high school if equal interest and effort is expended.

Nearly all of the equipment used in the radio-communication training program has been designed, constructed, or assembled by the writer who was often assisted by interested students and teachers. The largest piece of purchased apparatus was the McElroy graphic keying unit and tape puller. The sending keys used on the code tables during the first year and a half were home made keys made by radio students who also were taking machine-shop work. Regular manufactured keys have since been installed. Many of the switches on the tables were also homemade, being assembled by vocational-school boys. Wire for connecting up the code tables came from various scrap sources including a burned-out transformer. Obsolete radios were dismantled for parts. Headphones were gradually obtained from co-operative individuals in town, although working parts from several different sets often had to be put together to get a complete headset that would function. In fact, most of the equipment might be described as a product of home talent — but it works!

Some of the special techniques and methods used at Northbridge High School are presented herein for the guidance of school administrators and teachers interested in offering courses in radio communication.

Outline of Work

Training is given in the following forms: (1) Beginner's code; (2) Advanced code; (3) Radio theory; (4) Code typing. Here, in outline form, are the most important points of the training program:

Broad Aims

1. To aid in preparing students for possible communication work in the armed services of the United States.
2. To aid in preparing students for possible communication work in the commercial field.
3. To impart knowledge of methods of communication which may serve the student in times of emergency.
4. To form the basis of a possible hobby in the field of amateur radio.

Radio Code — Beginner's Code Classes

1. To learn the *sounds* of all characters *A* to *Z* and numerals 1–0, and some important punctuation marks
2. To develop ability to copy on paper, simple words and sentences with punctuation
3. To develop ability to copy these simple words and sentences up to a speed of approximately *five* words per minute

Time: fifteen minutes per school day (8:05–8:20 a.m.). Course of 20 weeks duration. Repeated during second half year.

Place: Instruction carried on over the RCA sound system, shown in Figure 1. It is carried to any or all rooms where there are students who wish this instruction.

Equipment: Audio-oscillator with key; RCA sound system with microphone.

Course Outline: Letters, numerals and punctuation taken up in groups following the A.R.R.L. method as given in *Learning the Radiotelegraph Code Booklet*.

Prerequisites: (1) Interest in learning code. (2) Open to all senior and junior high-school boys and girls.

School Credit: One half point credit for those able to pass five-word-per-minute test given in June.

Radio Code — Advanced Code Classes

Aims: (1) To review all characters taken up in the beginner's classes.

2. To develop the ability to copy these characters at gradually increased speeds.
3. To give practice in copying cipher groups using either letters or numerals.
4. To give practice in copying messages in the forms as used by the signal corps for its tactical messages.
5. To give practice in copying straight language material.
6. To develop ability to copy these types of material at speeds from 10 to 15 or more, words per minute.

Time: Fifteen minutes per school day (8:05–8:20 a.m.). Course of 20 weeks duration. Repeated during second half year.

Place: Instruction carried on over RCA sound system to any or all rooms where there are students who wish such instruction.

Equipment: Figure 2 shows a McElroy graphic keying unit, and a McElroy tape puller; fifteen Rolls of Signal Corps tape — graphic type; Microphone; RCA sound system; Homemade siphon tape recorder and key — for making special tapes.

Course Outline: Work progresses through the fifteen rolls of signal corps tapes as supplied by the McElroy Co. Work also includes instruction with many special straight language tapes made on our homemade siphon tape recorder.

Prerequisites: (1) Completion of beginner's-code course. (2) Interest in continuation of study of code. (3) Open to all senior and junior high-school boys and girls.

School Credit: One point credit for all those able to pass twelve-word-per-minute test given in June. If a half-point credit has already been granted for passing five-word-per-minute test, the student receives the other half credit to make the total 1 point.

Radio Theory

Aims: (1) To learn the basic fundamentals of radio communication theory.

2. To learn the appearance, construction, and function of component parts used in radio apparatus.
3. To construct simple receiving and transmitting apparatus using such parts.
4. To further increase ability to copy code at speeds up to, and possibly above, twenty words per minute.
5. To develop ability to send code at speeds between fifteen and twenty words per minute.
6. To prepare for F.C.C. amateur-operator's license examination to be taken at the customhouse, Boston, Mass., in June.
7. To give practice in blinker reading.
8. To give practice in copying code directly from the "air" by means of long-wave and short-wave receivers.

Time: Full period of 45 minutes. Full year course of 40 weeks. Code and theory time apportioned.

FIG. 1

FIG. 2

Fig. 1. The author at the controls of the RCA sound system. Fig. 2. McElroy graphic keying unit and McElroy tape puller. Note reels of special straight language tapes, and practice rolls made on our own recorder. Cables and microphone connect to RCA sound system

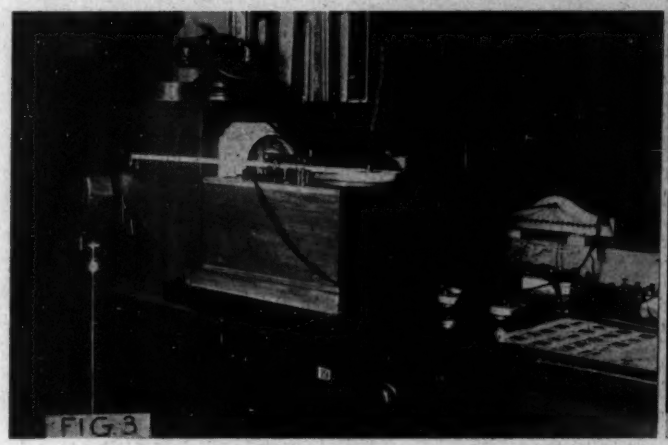
FIG. 3

FIG. 4

Fig. 3. Homemade siphon tape recorder in position at instructor's position. Note how tape passes into cabinet to tape puller. Fig. 4. Code tables wired for fourteen positions complete with accessories. Students in position and copying code

Place: Regular classroom.

Equipment: Code tables especially wired for 14 positions complete with phones, keys, switches, receivers, and oscillators. See Figure 4. McElroy graphic keying unit used to send code to all positions. Students may work singly or combined into any desired groups. This grouping is accomplished entirely by switching, while students remain at their own positions. See Figure 5. Blinker light is keyed by the McElroy unit so as to send code automatically. The radio receivers shown in Figure 6 are used for actual practice in copying messages from the air. The homemade siphon tape recorder, shown in Figure 3 is used to record student's sending. This permits the teacher to point out individual sending errors. Recorder is also used to make tapes of straight language or special copy material.

Textbooks: (1) *Elements of Radio,* Marcus and Horton, published by Prentice-Hall. This book is supplied by the school department.

2. *A.R.R.L. Radio Amateur's Handbook.*
3. *A.R.R.L. Course in Radio Fundamentals.*
4. *A.R.R.L. Learning the Radio Telegraph Code.*
5. *A.R.R.L. License Manual.*

These last four books are purchased by the individual students.

Reference Books: (1) *Fundamentals of Radio,* by Everitt and others. Prentice-Hall, Inc., 70 Fifth Ave., New York, N. Y.

2. *Principles of Radio,* Henney. Wiley and Co., 440 - 4th Ave., New York, N. Y.
3. *Radio Physics Course,* Ghirardi. Radio Tech. Pub. Co.
4. *Fundamentals of Radio,* Terman. McGraw-Hill Book Co., 330 West 42nd St., New York, N. Y.
5. *Basic Radio,* Hoag. D. Van Nostrand Co., 250 - 4th Ave., New York, N. Y.
6. *The Radio Manual,* Sterling. D. Van Nostrand Co.
7. *Practical Radio Communication,* Nilson and Hornung. McGraw-Hill Book Co.
8. *Radio Operating: Questions and Answers,* Nilson and Hornung. McGraw-Hill Book Co.
9. *Radio I and II,* Williams and Scarlott. American Book Co., 88 Lexington Ave., New York, N. Y.
10. *Radio: Study of First Principles,* Burns. D. Van Nostrand Co.
11. *How to Pass License Examinations,* Drew. Wiley and Co.
12. *Understanding Radio,* Watson, Welch and Eby. McGraw-Hill Book Co.
13. *Introduction to Practical Radio,* Tucker. Macmillan Co., 60 Fifth Ave., New York, N. Y.
14. War Department Manuals: TM11-432, TM11-455, TM1-470.

Course Outline: Work covers entire contents of the text *Elements of Radio* followed by a study of laws and regulations governing amateur radio stations and a concentrated review and practice for the Amateur License Examination.

Prerequisites. (1) Interest in Radio. (2) Preferably a background of Mathematics and Science. (3) Preferably completion of Beginner's Code. (4) Completion of Advanced Code highly desirable. (5) Course open to both boys and girls of Grades 11 and 12. Students in Grade 12 have preference, followed by Grade 11 until class is filled.

School Credit: Course is regular part of school's program of studies. Credit is 5 points toward graduation.

Code Typing

Special High-Speed Code Work (Audible)

Aims: (1) To co-ordinate code copying ability with typing ability.

2. To build up copying speed to above that used in hand copying to the maximum ability

FIG. 5

FIG. 6

Fig. 5. Individual student position showing two-way switch used to connect headphones to either code machine for receiving or to constant tone for sending. Also note 16 point inter-connecting device above position. Fig. 6. Radio receivers, both long wave and short wave, as used to give students actual practice in copying signals direct from the air

Fig. 7. Student typists working at the special wooden channel for tape as used for high speed code typing (visual)

Fig. 8. Instructor's position showing timing clock, hand telephone, monitor switch, and control switches

of individual student. (25 or 30 w.p.m.)

Time: Mostly after school hours as the typewriters are in full use during school hours for regular typing classes.

Place: Code tables.

Equipment: Code tables and all associated apparatus as previously described.

Typewriters carried from typing room to code room.

Course Outline: (1) Work with Signal Corps tapes.

2. Work with straight language tapes made on recorder.

3. Work with long wave and short wave receivers to get practice in actual copy from the air.

Prerequisites: (1) Interest in code typing. (2) Code copying ability. (3) Typing ability. (4) Open to any code students or members of radio theory class.

School Credit: None.

Code Typing

Special High-Speed Code Work (Visual)

Aims: (1) To learn the appearance of all code characters as *seen* on graphic type tapes.

2. To learn how to transcribe such characters to paper with a typewriter.

3. To develop ability to visually transcribe such tapes with a typewriter at *high speeds.*

Time: (1) One or two periods per week when available from regular typing class periods. (2) Some special work after school hours. (3) Duration of work approximately 10 weeks. (4) Course given during last half of year only.

Place: Typing room.

Equipment: (1) Specially constructed wooden channel for tape, with accessories. See Figure 7.

2. 15 roll set of signal corps tapes—graphic type.

3. McElroy tape puller.

4. Typewriters.

Course Outline: Work progresses through the various rolls of signal corps tape and special straight language rolls starting with small groups of characters at slow speeds and working up to complete messages at high speeds.

Prerequisites: (1) Interest in high-speed code work. (2) Completion of at least beginner's code course, and preferably advanced code. (3) Open to members of the senior typing class (3rd year) *only.*

School Credit: None.

Special Techniques and Methods

Beginner's code is hand sent by the writer. The audio tone coming from the oscillator feeds into the microphone at the RCA sound-system control panel as does the instructor's voice so that comments and explanations can be made as the lesson progresses with no switching from voice to tone, or vice versa. This greatly simplifies the conduct of the lesson. All lessons are typed out beforehand and are carefully gauged to the available time. This procedure can be highly recommended as it gives a "finish" to the lessons unobtainable without it.

Originally code lessons were sent to *all* students in *all* rooms in both buildings during a special 15-minute period set aside each morning for code *only.* Experience has shown that once interest in code has been aroused throughout the school it is more desirable to have all students interested in code assemble in special rooms where *all* students in the room will be working on code. The rest of the rooms are then cut off.

Advanced code is machine sent on the McElroy graphic keying unit. The output of this code machine is sent over a second channel on the RCA sound system to the special advanced code rooms at the same time as the beginner's classes are going on in their rooms. The machine is in charge of a student assistant who copies what is sent, or consults printed copies of the roll's contents, and reads it back over the microphone for checking purposes.

Radio theory being a regular school class comes one period a day throughout the school year. The available time is apportioned between theory and code. Code work is given at the specially wired code tables and consists of *both* receiving and sending practice. The F.C.C. amateur operator's license examination requires a speed of 13 words per minute both receiving and sending so that speeds of 15 words per minute, or more, must be obtained in class to allow for nervousness when taking the examination at the radio inspector's office.

A great deal of thought and work has gone into the construction and wiring of the code tables. The setup is too complicated to fully explain here, but a few of the unusual features will be discussed.

There are two channels feeding to each position at the code tables. One carries the output of the McElroy code machine. The other may be made to carry any one of six types of signal, namely: (1) constant tone; (2) phonograph; (3) broadcast receiver; (4) long-wave receiver; (5) short-wave receiver; (6) instructor's voice. At each position the student has a two-way switch which connects his headphones to either channel at will. When receiving practice is carried on the switch is thrown to connect to the code machine. When sending practice is carried on the constant tone is placed on the second channel and the student throws his switch in the opposite direction which allows him to hear this tone each time he presses his key. The unusual feature of this system is that the student may listen to a letter as sent by

the code machine, flip the switch, and send the letter to himself, trying his best to imitate the *correct* sending of the tape. In this way good sending habits are formed from the start. One cannot send properly unless one knows exactly how each letter *sounds*.

Actual communication situations are simulated by means of a simple switching arrangement above each student's position. Each position is represented by a pin which can be connected to by means of a clip. For example, should a student at position No. 2 wish to communicate with the student at position No. 10, he would merely place his clip on pin No. 10. Then, when he pressed his key, not only would he hear the tone in his headphones, but the student at position No. 10 also would hear the tone. Likewise, when the key is pressed at position No. 10 the tone is heard at positions No. 10 and No. 2. Hence, the two students are in two-way contact much as they would be over the air. The students can be grouped in innumerable ways by this arrangement. All students may be put on the instructor's channel by having all clips put on the instructor's pin which is No. 1.

An electric clock with a sweep-second hand has been wired up with a contact so arranged that once a minute, as the second hand passes the contact, a *peep* from the constant tone channel may be put on the code-machine channel. In this way the students may mark their papers once a minute as the tone is heard and thus be able to count words-per-minute to judge their own copying speeds.

The instructor's position has a monitor switch so connected that by turning the switch it is possible to listen-in on *any* student position while the student is practicing sending. A hand telephone may be connected with the free channel in such a way that the instructor may *speak* to the sending student to comment on his sending without moving from the instructor's position. The instructor may also send code to the student to illustrate the proper method. See Figure 8.

Actual practice in copying from the air is obtained by putting either the long-wave or the short-wave receiver on the second channel so that the signal appears at each student position.

Blinker training is given by means of a small flashlight lamp supported on one of the table posts. The output of the McElroy code machine is sufficient to light this lamp. The dark curtains may be pulled down and the room completely darkened so that the lamp seems to be far away, thus simulating actual conditions. Experience has proved that blinker is easily copied if the student *first* has learned code by ear. To try to teach blinker without first teaching the code audibly seems to be a mistake.

A siphon tape recorder was made by a group of interested students working with the machine-shop and woodworking instructors and the writer. With the recorder a great many rolls of tape have been made including special straight-language rolls, special practice rolls for the beginner's classes, special rolls with punctuation marks, and special rolls for testing purposes. Also the recorder sees service in recording the sending of the students at their own positions at the code tables. A special circuit connects the student's key to the recorder when it is set up at the instructor's position. One student after another may send his message and have it recorded without moving from his position. As soon as the ink is dry, a matter of only a moment, the tape may be run through the code machine so that each student may actually *hear* how his sending sounds. This is essential if the student is to learn correct sending.

In addition to the study of theory and code, this class spends some time with actual apparatus. Construction of simple receivers, oscillators, power supplies, and the like, is undertaken. Parts from dismantled obsolete broadcast receivers, and from surplus signal corps material, are used in this work. However, since time is extremely limited, most of this work is of a voluntary nature and is carried on after school hours.

The special high-speed code typing (visual) is an unusual feature. It has proven most interesting to both the students and the instructor. It is amazing how soon the typists pick up speed. In no time, it seems, they can transcribe 25 words per minute. The special wooden channels were designed by the writer and constructed by the woodworking department.

A great deal of credit for the solution of many of the mechanical problems should go to the vocational school, to the machine-shop department, and to the woodworking department. Above all, credit is due Mr. Harrie J. Phipps, Superintendent of schools, and Mr. Payson H. Reed, principal of the Senior and Junior High School, for their interest and co-operation without which this program of radio training could never have been carried out.

Special Results Obtained

Although this work is now only in its fourth year, many former students are, or have been, in the armed forces, or in related work, in the field of communications. Some outstanding examples are mentioned here.

Two boys, whose only work in radio was code typing (both audible and visual) served in the U. S. Navy as radioman and signalman respectively. A girl who took only code typing (visual) became so interested in radio that after graduation from high school she went to a radio school in Chicago and is now working in a radio laboratory in Washington, D. C. Another girl who took radio theory obtained her amateur license. However, the radio bug had bitten her so hard that upon graduation she went to radio school in Boston to obtain her commercial licenses. She visited us the other day and showed us her commercial second-class telephone and second-class telegraph licenses and an amateur class *A* license. She now has a job with RCA as receiving operator at the world's largest receiving center at Riverhead, L. I. Several boys who took radio theory passed the Navy's Eddy Test and are enrolled in the Navy's radar courses.

Our prize student was a boy who worked with us for two years. He was student instructor in charge of the code machine for both of these years. He assisted the writer in the detailed job of building and wiring the code tables. He had a hand in the building of the recorder. At the same time he worked and studied hard and obtained *all* the amateur and commercial licenses it is possible to get — and all before he graduated. He worked with the state police during the summer following his graduation as a radio operator and technician. Upon approaching his eighteenth birthday he joined the Merchant Marine as radio operator. Now, he is chief radio officer on his ship, and has a commission as ensign in the Maritime Service. I understand that he has even now all the qualifications for a lieutenant's commission, but his youth is preventing him from accepting it.

Representatives of both the U. S. Navy and the U. S. Army have visited us and have expressed both their surprise and their approval of what we are doing. Their interest prompted the writing of this article, and the writer hopes that it will create increased interest among schoolmen, and that courses in radio communication will soon be offered in *every* high school.

Selected Sources of Material and References

McElroy graphic keying unit and McElroy tape puller. Fifteen roll set of signal corps tape (graphic type). McElroy chart of radio codes and signals (wall chart). McElroy method for transcription of radio telegraphy signals (All obtainable from: McElroy Mfg. Corp., 82 Brookline Ave., Boston, Mass.)

Radio Instruction Course — Wall Charts No. 1—No. 4. Lesson Folders 3A, 3B, 3C to be used with above chart No. 3. (All obtainable from: Educational Staff, Sylvania Electric Products, Inc., Emporium, Pa.)

Free motion-picture films, "Radio at War"; "Electrons on Parade"; "Television." Sponsored by Westinghouse. (All obtainable from: William J. Ganz, The Institute of Visual Training, 40 East 49 St., New York 17, N. Y.)

Free motion-picture films — signal corps training films. (All obtainable through your service command headquarters.)

Film Strips — "Fundamentals of Electricity" — Jam Handy Film Strips. (All obtainable from: The Jam Handy Organization, 2900 E. Grand Blvd., Detroit 11, Mich.)

Radio Operator's Code Manual With Touch Typing — Wayne Miller. Published by Ziff Davis Publishing Co., 540 North Michigan Ave., Chicago, Ill.

"Teaching Radio in High School," by James Perkins Saunders, W1BDV Q.S.T., *Amateur Radio Magazine*, June, 1943. Published by A.R.R.L., The American Radio Relay League, Inc., West Hartford, Conn.

An Outline of Course Instruction for the Prevocational Class

E. T. Barnett and J. F. Swigert***

Introduction

A few students enroll in courses in vocational training simply because it seems to be an easy unit of work to be applied toward graduation from high school. The student who takes this training just to get out of something else that is not as much fun, must learn as a result of experience and teaching that this training is to be used and is not simply a medium of getting high-school credit. There is little value in a student attending vocational classes unless he has had an opportunity to determine for himself the reason for taking vocational training. He must have an end in view in which he will use this training either directly or indirectly in the occupation which he intends to follow. We are, therefore, listing the general objectives, specific objectives, and the procedure used in the operation of this class. Since this class operates on one-hour schedules, it safeguards students entering the full three-hour vocational classes without having first made full investigation regarding his vocational training program.

General Objectives

I. To teach applications of science and mathematics common to many trades.

II. To give problems of both shop and related technical procedure to students. This will assist them in determining the general kind of skilled occupation they would be best fitted to follow whether of a professional or of a trade nature.

Specific Objectives

I. To teach shop mathematics with application to a particular job or shop operation.

II. To teach science related to a job upon which the student works in the class shop.

III. To develop the ability to make layouts for the parts of simple sheet-metal projects.

1. Simple sheet-metal work is used because its successful and satisfactory accomplishment demands of a student the use of the following elements essential in all trades and professions.
   - *a*) Accuracy
   - *b*) Applied mathematics fundamental to many skilled occupations
   - *c*) Use of blueprints, shop sketches, and layouts
   - *d*) Use of both hand and machine tools
   - *e*) Satisfactory use of many measuring devices common to numerous skilled occupations.

IV. Constructive emphasis is placed on the prompt and correct finishing of any project once undertaken. This continues to build up an attitude of work and the satisfaction gained in the final completion of a job well done, rather than the general haphazard attitude of playing and ultimately accomplishing a job of little or no value. This procedure also develops an employer-employee attitude generally necessary for success in an occupation.

Methods

The first six weeks and the last four weeks of the year are spent on shop mathematics. The following tests are used during the year and the results are recorded and filed in the vocational school office for future reference.

1. Kuder Preference Record and Profile Sheet
2. MacQuarrie Test for Mechanical Ability
3. Rogers Achievement Test in Mathematics for Technical and Industrial Schools
4. Job application sheet

At the beginning of the year each student is asked to express a preference for the type of shopwork in which he intends to enroll during his junior and senior years. The vocational department gives training in machine shop, mill and cabinetwork, vocational agriculture, auto mechanics, and apprenticeship. After the student has indicated his preference, he is transferred to one of the above shops for a period of two to three weeks. During the first semester of the year each student will have an opportunity to spend at least two weeks in all of the other vocational classes. Early in the second semester the student is again asked to indicate his preference for future vocational training. If he has not had sufficient information and experience in the other vocational classes to decide, he is given another opportunity to spend a short time in that class in order to make a definite decision. A record is kept of the student's decisions concerning the type of training in which he is most interested at the beginning of the year, at the second canvass—in the beginning of the second semester—and again at the end of the year.

Procedure in Classwork

In prevocational class work, each student is required to develop an accurate layout pattern for specific projects. Since sheet metal requires the use of both fractional and decimal measurement, the transition from the applied mathematics work to the shopwork at the end of the first six weeks, is easily accomplished by blackboard sketches and the laying out of patterns for projects to be made in the shop.

Emphasis is placed on the ability to measure accurately, transform sketches to working drawings on paper, and to transfer these patterns from the drawings to the working material—in this case, mainly sheet metal. This is followed by forming the project, and by keeping within specified limits of error on the finished project. Experience in reading commercial type of blueprints is also given at this time.

Instruction is given in the use of various pieces of equipment—such as acetylene torch, small machine lathe, squaring shears, sheet-metal brake, power band saw, power table saw, combination bench machine, setting down machine, universal rotary machine, floor type drill press, and electric tool grinder. The students are given instruction in the use of the following hand tools: common roller, steel square, micrometer, hand shears, forming hammers, rivet sets, soldering coppers, and other small tools related to sheet metal, machine shop, and woodworking operations. The student also learns to use various charts such as decimal-fraction equivalent chart, sheet-metal thickness gauge, tap and drill size charts, and drill gauges.

Slide and sound-film reels, which we are able to secure from various sources such as manufacturers and the department of visual instruction at Oregon State College, are shown to the students. Films from manufacturers are shown to present various types of occupations and the need for acquiring a variety of skills essential to the mass production of articles for public use. This further emphasizes the need for students acquiring fundamental skill and understanding so that they will be able to find a successful place for themselves in the future. Other members of the department give talks concerning interesting experiences in their trade. Two to three weeks before the end of the school year each student is given a private conference to discuss any or all work they expect to take during the coming school year. Also, some time is spent concerning summer work, and employment after graduation from high school. Special problems concerning other courses offered in the high school are discussed with the student by the heads of specific departments. In cases where the student is uncertain of the training required in special jobs, he is recommended to consult men who are em-

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ployed in that type of work. In each case, the student is requested to report back for an additional conference on the information gained in these discussions. At the end of the year the student should be able to make his selection for the type of training to be taken during his junior and senior years will will fit him to enter a skilled occupation after graduation from high school.

Outline of Related Mathematics for the Machine Shop

*Francis G. Huss**

Students develop accuracy and facility in numerical computations, mainly through:

a) Problem solving in which there is progressive growth in the student's understanding of the nature of the fundamental operations and the power to apply them in new situations.

b) The pupil's exercise of common sense, judgment, and judiciousness in computing from approximate data, his familiarity with the effect of small errors in measurements, the determination of the numbers of figures beyond the decimal point to be used in computing and to be retained in the result, and the degree of accuracy to be maintained under certain work conditions.

c) The development of self-reliance in the handling of the numerical problems through: (1) Self-checks. (2) Co-operation in the testing program. (3) Tests administered at frequent and regular intervals. (4) Practical applications of results of calculations.

The second general aim of the program is to increase the student's ideas, concepts, and vocabulary of technical and industrial terms in general and of his trade in particular as far as wording of problems, discussion for explanatory purposes, and classroom time will permit.

Sophomore Mathematics — First Semester

Student's Goals

1. To understand and use simple formula
2. Ability to make simple mental computations using fractions
3. Increase vocabulary in technical terms
4. Ability to handle the fundamental processes
5. To understand degree of accuracy

Course A

Ten-minute quiz (daily except test days) of mental computations.

This work continues intermittently throughout the sophomore year and into the junior year.

Course B

1. Review fractions — additions, subtractions, divisions, multiplication
2. Review decimals
   a) *Drill work* covering written problems, problems from sketches on ditto paper and blueprints
   b) *Use of fractions and of decimals* in formulas
3. Square Root — Perfect squares, inexact square root, fractions, whole numbers and decimals, square root in formula, right angle and application
4. Areas of nonright angles
5. Uses of constants
6. Areas of circles
7. Volumes
8. Weights and costs

Sophomore Mathematics — Second Semester — Algebra

Student's Goals

1. Ability to handle operations of numbers in general
2. Ability to treat formula as simple algebraic equations
3. Ability to understand and interpret correctly graphic representation

Course

1. Notations, definitions, and symbols in algebra
2. Simple use and meaning of the exponent
3. Evaluating by numerical substitution in simple algebraic expressions and formulas — meaning of grouping symbols and order of operations
4. Drill work here to include formulas more advanced than those of first semester but using fractions, decimals — emphasize grouping symbols
5. Derivation of formulas
6. Combining similar terms
7. Addition
8. Subtraction
9. Multiplication
10. Division
11. Simple fractions
12. Simple equations — equations involving fractions — equations containing parenthesis
13. Formula treated as equations — taken from machinists' handbooks
14. Factoring
15. Formulas involving factoring
16. Graphs

Junior Mathematics — First Semester — Geometry, Geometrical Applications, and Mensuration

Student's Goals

1. Familiarity with geometric forms common in industry and life
2. Development of space — perception
3. Exercise of spatial imagination
4. Recognition of problems and of methods of attack for possible solution

Course

1. Three weeks of review of work covered in sophomore year
2. Introduce the subject of geometry; discuss need for geometry, program of work, objectives to be obtained, need for knowledge of certain propositions and the understanding of their application
3. Information sheets — definitions
4. Angles and applied problems
   Prop. I: If two straight lines intersect each other, the opposite angles are equal — problems
   Prop. II: If two straight lines are cut by a third line, the alternate-interior angles are equal — problems
   Prop. III: If two straight lines are cut by a third line, the exterior-interior angles are equal — problems
   Prop. IV: The sum of the three angles of any triangle is equal to 180 deg. — problems
   Prop. V: The sum of the degrees of the interior angles of a polygon of N sides is equal to $(N-2)$ times 180 deg. — problems
   Prop. VI: Two angles are equal when their sides are parallel, each to each — problems
   Prop. VII: The exterior angle of a triangle formed by prolonging one side is equal to the sum of the two opposite interior angles — problems
5. Solution of right-angle triangle problems, recognition of problems and means of attack
6. Areas and volumes

Information sheets on circle

   Prop. VIII: Through any three points, not lying in a straight line, one circle, and only one, can be drawn
   Prop. IX: If tangents to a circle from an external point are drawn, they make equal angles with the line joining the given point to the center, and their segments from the given point to the points of contact are equal
   Prop. X: An inscribed angle is measured by half the intercepted arc.
7. Areas of circles, segments and sectors
8. Volumes

Information Sheet — Proportion

9. Drill in proportion with special reference to similar figures
   Prop. XI: If two chords interesect in a circle, the product of the seg-

*Director, Vocational Education, Lansdale, Pa.

ments of one is equal to the product of the segments of the other
10. Review of principles

Junior Mathematics — Second Semester — Trigonometry

Student's Goals

1. To recognize problems and apply methods of solution
2. Ability to analyze
3. Ability to use trigonometry in layout work
4. To co-operate with fellow students in working through problems

Course 1

On the basis of individual performance in the first semester the class is divided into two groups:

Group I — Average Ability Group

1. Meaning of trigonometric functions
2. Calculation of 30-, 60- and 45-deg. trigonometric functions from equalateral triangle and from square
3. Check calculated function values of 30-, 60- and 45-deg. angles against those found in tables
4. Use of tables
5. Solution of right triangles
6. Layout of angles by use of trigonometry and drawing instruments
7. Miscellaneous trigonometry — written and sketches
8. Layout problems
9. Drill work — miscellaneous problem sheets — all sketches

Spirals

10. Formulas
11. Solution of oblique triangles

Group II — Superior Ability Group

Items 1, 2, 3, and 4, same as for Group I

5. Group excused from examinations and all work similar to Group I except layout problem

Group working together use for their textbook Wolfe and Phelps, *Practical Shop Mathematics No. II*, Advanced-Publishers, McGraw-Hill Book Co., 330 West 42 St., New York City.

Make claymodels of certain of the figures

1. Work compound angle problems
2. Work compound angles applied to the mounting of parts on adjustable angle plates

Senior Mathematics

Student's Goals

1. Ability to solve technical and industrial problems of a mathematical nature in the pupil's own field of specialization
2. Ability to recognize a shop problem, to analyze it into its component parts, and to reach a solution effectively and economically

Course

1. Three weeks of review of fractions, decimals, square root, equations, formulas, applied geometry, and trigonometry
2. Percentage and applications
3. Ratio and proportion applications of — cost problems, alloy and mixture problems, shop problems, etc.
4. The high ability group formed in the second half of the junior year is encouraged at this point to continue with the work in Wolfe and Phelps, *Advanced Machine Shop Mathematics* and to cut and grind calculated problems in the shop
5. Average ability group
6. Pulley and gear speeds
7. Speeds and feeds
8. Gears
9. Indexing
10. Graduated dial work
11. Shop bookkeeping
12. Intensive review of all work covered

Veterans Aiming To Become Industrial-Arts Teachers

*Willis B. Anthony**

Considerable interest is being gladly given to 15 young men enrolled as students in the industrial-arts department at the State Teachers College in Fitchburg. These students, recently honorably discharged from the armed forces, are provided by the government with funds distributed through the G.I. Bill of Rights.

These men were fully qualified to meet the established standards required for admission, as will be the case with veterans applying later for admission. The State Department of Education has very helpfully extended the annual date line for taking veterans into the department.

Two of the department's graduates who are veterans are much pleased at their opportunity to take graduate courses presented on the campus for the first time to full-time students. This advancement leads to the granting of the master's degree which represents professional improvements now needed in promoting industrial arts in the schools.

Three other veterans have re-entered the department. These, with 27 undergraduates still in the armed forces, left their interrupted courses to enter the war. Ten other veterans are freshmen.

With all the interest and respect due these veterans, they would be the first to resent any separation of those who have or have not been in the armed forces, in the daily affairs of the department.

During the war there were comparatively few men in this industrial-arts department. Last January three young men entered and another came during the summer session. These with 16 additional students who were admitted as freshmen in September make a total of 20 new students.

In the prewar years the annual quota of admission was limited to 25. Twenty compared with 25 already shows a more rapid passing from wartime to peacetime numbers than had been anticipated.

One of the newly enrolled members came from Maine, a second from Connecticut, and a third from New Jersey. Entering students from Massachusetts have come from as far east as Newburyport and from as far west as Chicopee. Two have transferred from college levels of competence. Three were trade-school graduates; the others were graduated from high-school courses.

The men in this group represent a wider variety of occupational experiences than has been found among the entering students of previous years. These experiences will be very helpful to students in their courses in the department and in their later teaching of industrial arts.

Young men have come from paid positions in printing establishments, machine-shop practice, silversmithing, lumbering, cabinetmaking, electrical maintenance, painting, servicing of oil burners, welding, and ship carpentering. Others have come from such technical type of work as electrical analysis and civil engineering. One student was formerly an aircraft technician.

Never before in industrial arts has the outlook seemed more inviting for such students. More than ever before, the demand will quite likely exceed the number of young men who can be made available as teachers of industrial arts.

It is hoped that leaders and followers returning from the fighting front will join with others on the home front in encouragingly sanctioning future peacetime values in industrial arts.

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In a study made in Vermont, it was found that the average damage to an automobile involved in an accident was $56.20 when it was traveling 10 miles an hour or less. When the car was traveling over 50 miles an hour, the average accident damage was $454.67. — *Safety News.*

Problems and Projects

PROBLEMS FOR RELATED ELECTRICAL DRAFTING

FRANCIS I. LIBBY

Trades and Industrial Dept.
E. C. Glass High School
Lynchburg, Va.

The practice of routing students in electricity, on the trade and industrial level, through a complete and extended course of signal and power wiring is generally accepted and advised by instructors and administrators. Years of experience has demonstrated that instruction of this sort serves as a suitable introduction to the general field of electricity and provides a foundation upon which later studies may be based.

Every activity of the student's vocational program should be directed to the acquisition of the technical skills and information incident to this type of work because further progress by the student is dependent upon his mastery of this basic foundation. Consequently, the problems used in related drafting should parallel the practical shop experience of the students.

In the attempt to follow through with this idea, that is, in selecting and using in the drafting room, those problems that arise from the work in the shop, the mistake is often made of devoting too much time to diagramatic drawings.

Usually, the entire first year in the shop is spent in the study of power and signal circuits. If the matter of correlation is to be carried out between the related and shop subjects, a similar period of time should be devoted to wiring diagrams in mechanical drawing.

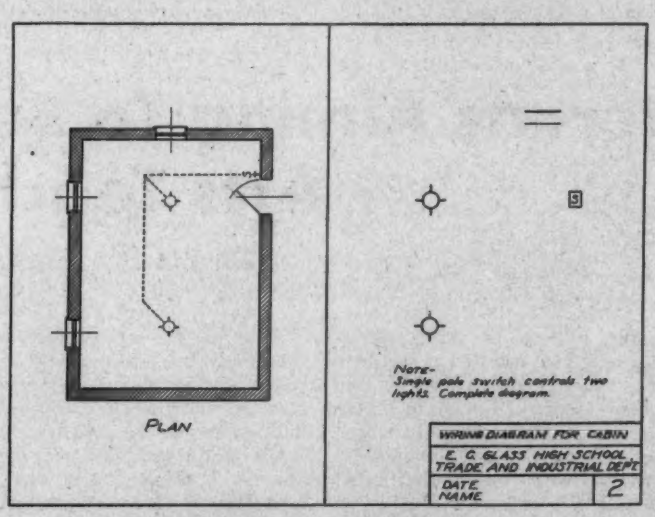
In the drafting room, however, the representation of the symbols and conventions may be mastered in a few hours. This presents a difficult situation for the drawing instructor. While the student from the drafting standpoint is capable of doing advanced work, he is prevented from doing so because he lacks the theoretical information required to solve the problems. Therefore, to prevent the first year of related electrical drafting from becoming a monotonous routine of diagramatic problems, every effort should be made to introduce into the subject any practical applications that may be adapted to the material.

In attempting to develop problems that would eliminate the monotony of devoting several weeks to the comparatively simple task of drawing circuits involving only minor changes in wiring arrangements, the type of problem suggested in the accompanying plates resulted. These are designed for power and lighting circuits but there is no reason for limiting the scheme to that kind of work. Problems of the same nature have been arranged for signal circuits.

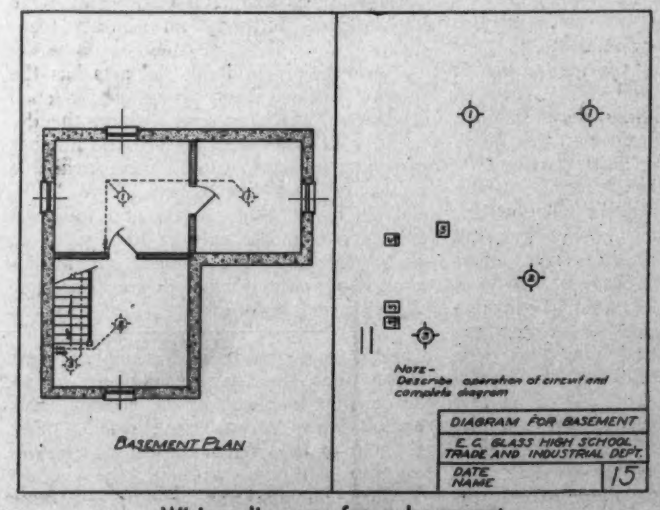
After the student has acquired proficiency in laying out diagrams, drawing symbols and indentifying wires using colored and black inks, simple plan arrangements are studied. The assignment is made by giving to the student a mimeographed or blueprinted layout showing the information as it would be indicated on a working drawing.

To save material, the sheet is divided into halves. The student is required to duplicate the architectural layout on one side of the sheet, and on the other he makes the wiring diagram for the circuit indicated.

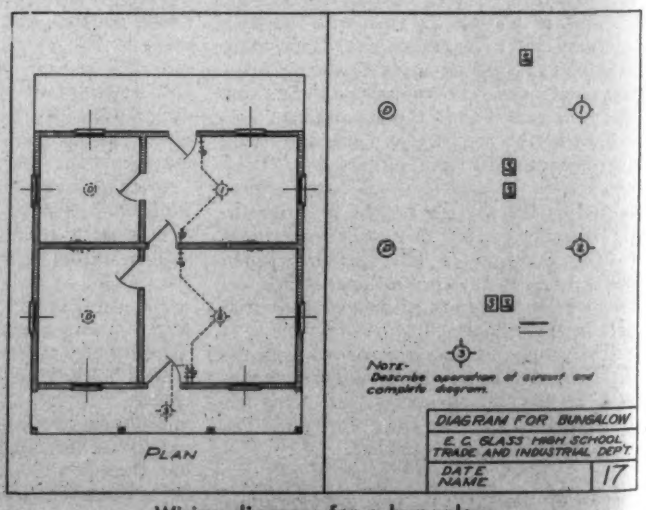
Variations of this type of problem are possible and practical. For example, the diagram and plan may be given, the problem being to work out the correct electrical layout for the system suggested. And, of course, it is but a short step from such problems to the customary commerical practice of laying out



Wiring diagram for a cabin



Wiring diagram for a basement



Wiring diagram for a bungalow

the electrical circuits for a building. This is, undoubtedly, the most important since it is from this sort of plan that electricians must work.

Vocational classes are often asked to do maintenance work in the schools and not infrequently have students, under the supervision of the instructor, undertaken the wiring of buildings. If drawings can be made for and used in this work, it will be a valuable experience because the more nearly the conditions, under which the students work, approach actual trade practices, the more quickly and easily will the individual pupils be prepared to enter the trade.

Such problems as those shown on the plates presented enlarge the content of the course by providing experience in construction and information concerning floor plans and the architectural conventions used on them. They also materially increase and develop the student's "stock in trade" by familiarizing him with the relationship between the circuits he is studying and their actual use in industrial practice. As electricians, these students will need a broad and comprehensive knowledge of plans and conventions.

In addition, the monotony of a prolonged study of a simple matter is not only relieved, but is also turned into a profitable and interesting experience.

Any teaching device which will correlate the technical and theoretical phases of the shopwork to actual trade practice is important and its use should be governed by the extent to which it increases the student's knowledge, ability, and understanding. A study of the accompanying suggestions will reveal ample opportunities for developing a course of practically any desired length and scope.

WHITTLING-JACKKNIFE TECHNIQUE

W. BEN. HUNT

Hales Corners, Wis.

(Continued from page 85 of the February, 1946, issue)

Owl

The little owl shown in Figure 201 is a very simple whittling job. The painting will probably present the greatest trouble. This owl, known as a Richardson's owl is not only an interesting job to whittle, but it is a very good-looking ornament after it is finished.

The bird is whittled separately and then mounted on a piece of dry branch with two small brads. Cut out the side view silhouette and then round up the figure. After the job has been sanded, drill holes for the brads into the branch and put a drop or two of cement where the bird is to rest. Or, if you have a suitable piece of wood, a stump may be whittled for a base, thus eliminating the trouble of searching for a suitable branch. If a natural branch is used, the bark should be kept on, while a whittled stump will have to be painted a weathered gray color with a touch of green moss here and there for contrast.

For painting the owl it is suggested that a colored picture of a Richardson's owl be looked up in some bird book. A fairly good job of painting can be done by making the body of the owl brown and white, as the photograph shows. The face is white and gray. The beak is black and the eyes are yellow with black pupils.

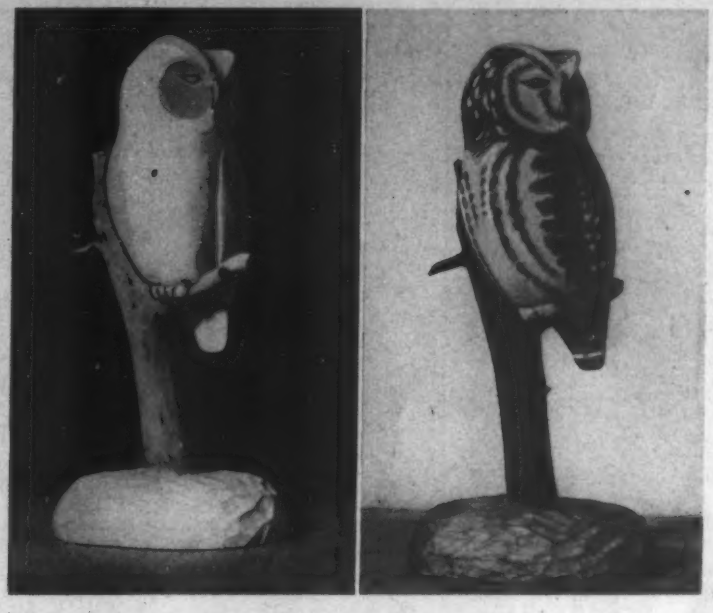


Fig. 201. Richardson's owl

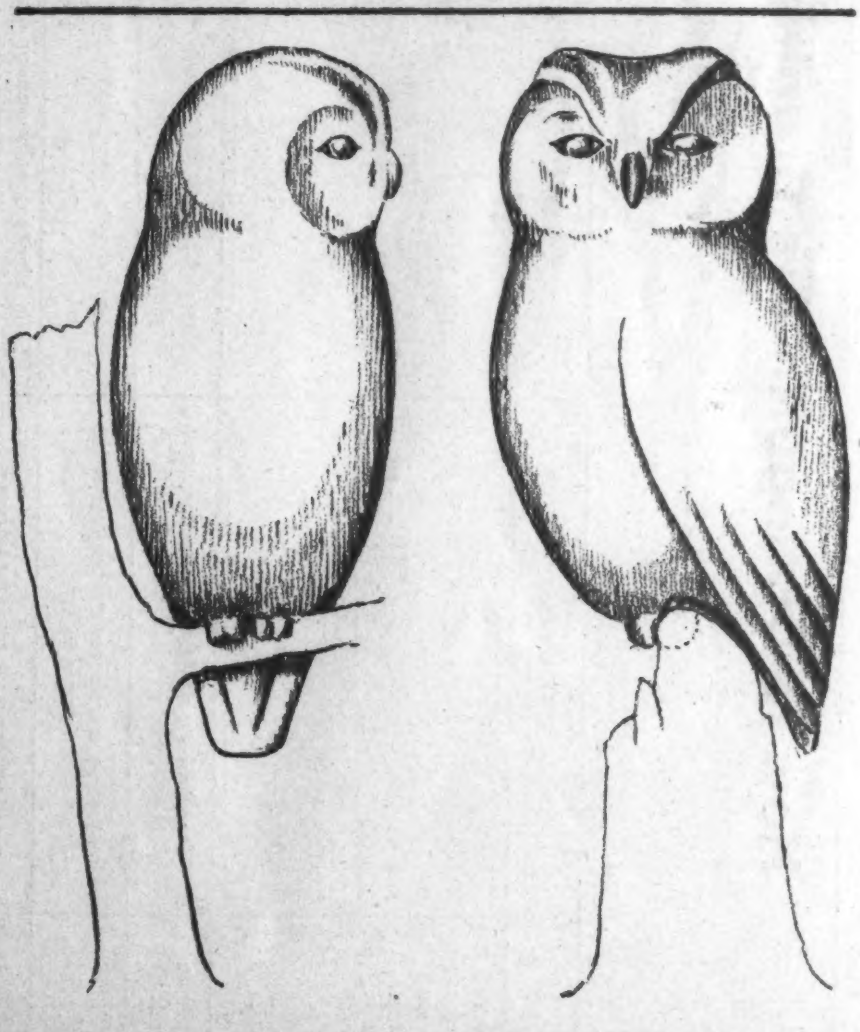
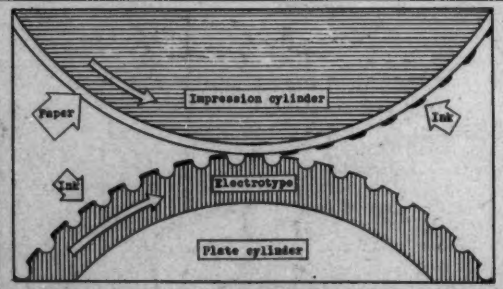
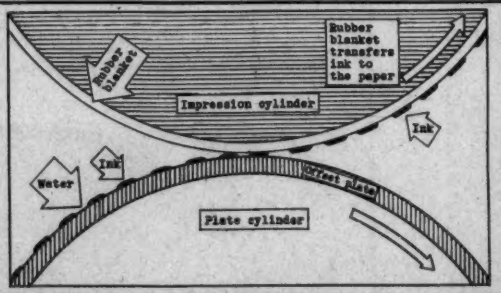
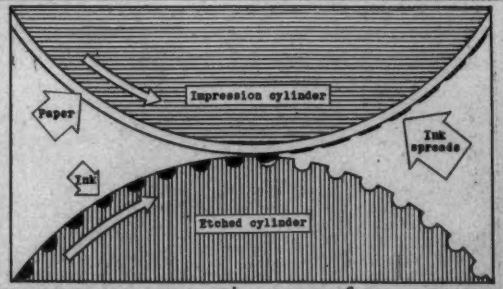
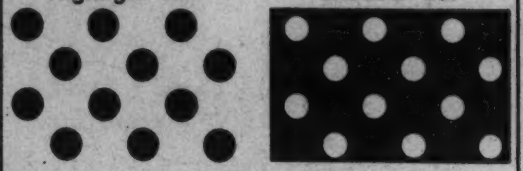
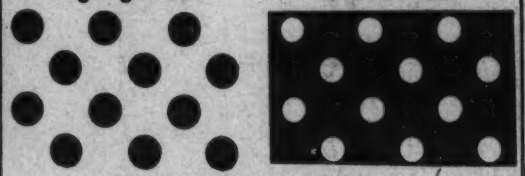
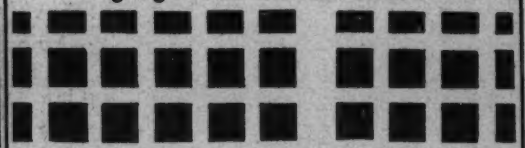


Fig. 202. Full-size pattern of the Richardson's owl

How to Distinguish The Graphic Arts Processes

Lieut. Comdr. R. Randolph Karch, U.S.N.R.

Publicity and Printing Office, Naval Base, Philadelphia 12, Pa.

	LETTERPRESS	OFFSET-LITHOGRAPHY	GRAVURE
Rotary Methods of each Process			
Examine Type	Often shows a slight impression on back of sheet—hold at an angle to light	Never shows an impression on the back of sheet—hold at an angle to light	All type is screened the same as illustrations—examine with a magnifying glass
Examine Line Engravings	Impression may show on back of sheet—hold at an angle to light	Never shows impression on back of sheet	Illustrations which appear as line are actually screened
Examine Ink	Usually appears as an intense black Detail is sharp	Solid blacks usually appear gray when compared with letterpress Detail usually less sharp than letterpress	Smooth, blending tones Detail not as good as in letterpress or lithography
Examine Halftone Dots	Highlight dot Shadow dot  Usually 120–133 line	Highlight dot Shadow dot  Usually 80–133 line	Highlight and shadow screen  Usually 150 line; ink tends to fuse and obliterate screen

Because of the extreme differences in quality of work done in letterpress and offset-lithography, it is often difficult to distinguish one process from another. Offset often looks like letterpress.

ORNAMENTAL TIN CRAFT

CHRIS H. GRONEMAN
Industrial Education Department
A. & M. College of Texas
College Station, Tex.

(*Continued from page 25 of the January, 1946, issue*)

Leaf Design Nut Tray

A leaf design nut tray is a novelty which will be welcome in any home. The use of a leaf design is not new, but it always attracts the attention of the onlookers. It offers many possible variations because any large leaf makes an ideal pattern. Forming and shaping of this project is quite simple because the extremities of the leaf edges do not limit the

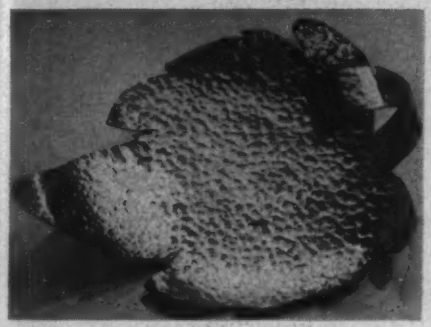


Fig. 1. Leaf design nut tray

tray to any exact line of depth. The stem may be widened to form an excellent handle, and to improve the general design of the tray.

The blank stock should be built up of two thicknesses of sheet tin. If any of the sharp edges should open in the forming process, a little soldering along the break will be necessary.

This project is also very attractive with an antique copper finish.

BILL OF MATERIAL

No. of pieces	*Item*	*Size*
2	Sheet tin	5 x 10
	Solder, flux, steel wool	

Tools: Asbestos sheet, brush, carbon paper, copperplating setup, emery cloth, files, forming block, flat iron, heating device, jeweler's frame and blade, lead or wood block, lead weight, peening hammer, pencil, rule, scriber, soldering copper, tempera water color paint —yellow, and tin snips.

Procedure:

1. Use design as shown in drawing, or develop an original one.
2. Cut out 2 pieces of tin stock.
3. Solder one side of each piece.
4. Sweat both pieces together with hot flat iron. Weight the soldered parts together immediately as more is sweated.
5. Apply coat of yellow tempera paint to one side of sweated piece for design transfer.
6. Lay design sheet and carbon paper over painted portion and trace design.
7. Cut out tray with jeweler's frame and blade.
8. File and dress edges with abrasive cloth.
9. Peen and form tray over forming block.
10. Rub nut tray with steel wool and prepare for plating.
11. Apply thick coating of copper.
12. Polish project with steel wool. Use cloth to prevent touching metal with hands.
13. Apply coat of clear metal lacquer and allow to dry.

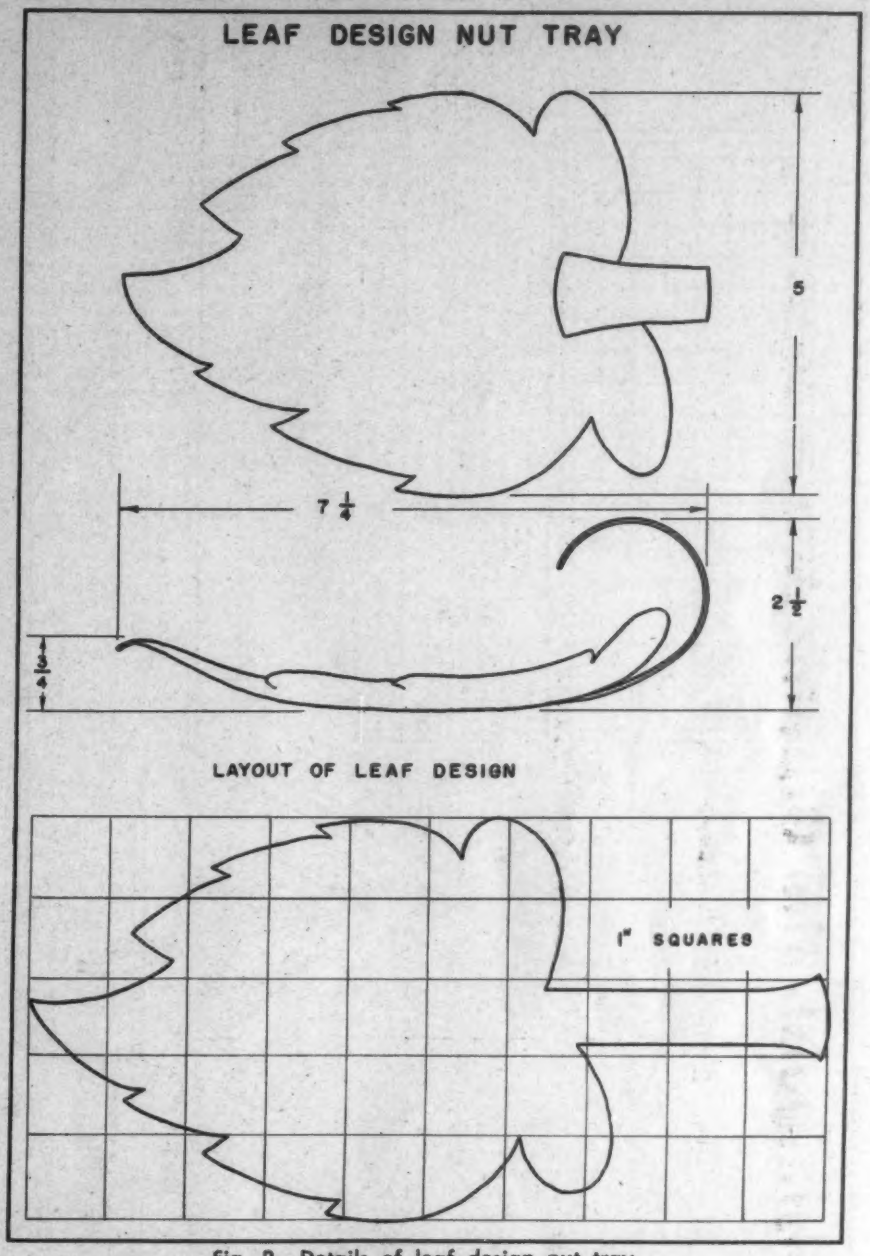


Fig. 2. Details of leaf design nut tray

LOUNGE CART

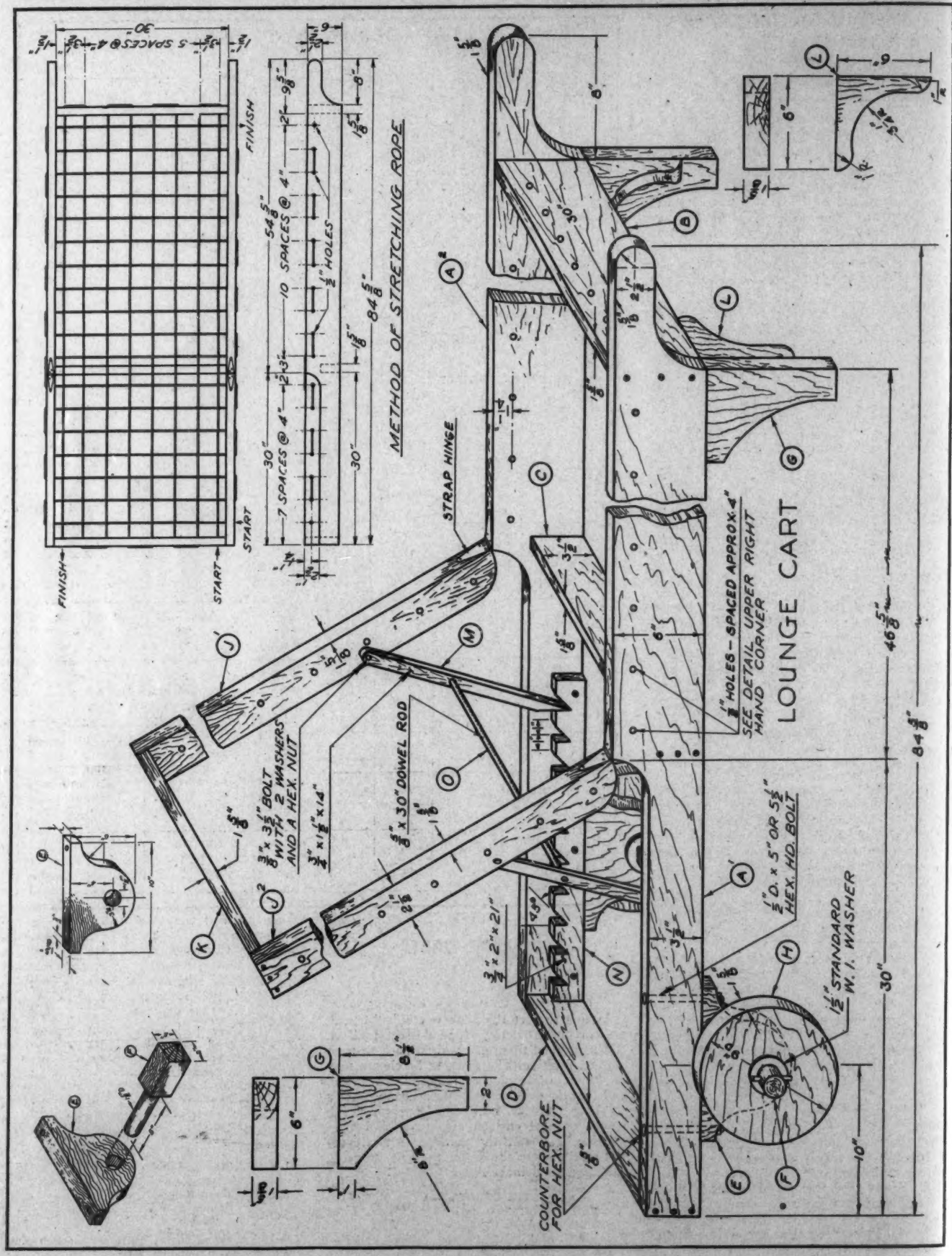
G. A. RAETH
Glendale, Calif.

In this project the back rest sidepieces, *J*, are cut out from the wide side seat rails, *A*. When reclined these pieces drop back to their original position. The stock to be chosen may be 1⅝-in. white pine or redwood. The width and length dimensions will accommodate a standard cot-size mattress. A similar full length channel cushion also may be bought which will answer the purpose. Separate detail sketches are shown for the axle brackets, axle, legs, and braces.

BILL OF MATERIAL

No. of pcs.	*Part*	*Name*	*Size*
2	A	(seat rails)	1⅝ x 6 x 84⅝
1	B	(end seat rail)	1⅝ x 6 x 30
2	D,C	(front and cross seat rails)	1⅝ x 3½ x 30
2	E	(axle brackets)	1⅝ x 6 x 10
1	F	(axle)	2 x 2 x 40
2	G	(legs)	1⅝ x 6 x 8½
2	H	(wheels)	1⅝ x 9 D.
2	J	(side back rails)	1⅝ x 2½ x 30
1	K	(end back rail)	1⅝ x 2½ x 30
2	L	(end and leg brackets)	1⅝ x 6 x 6
2	M	(back braces)	¾ x 1½ x 14
2	N	(notched strips)	¾ x 2 x 21
1	O	(dowel rod)	⅝ D. x 30
4		Standard hex. head bolts and nuts	½ D. x 5 or 5½
2		Standard bolts and nuts	⅜ D. x 3½
2		Strap hinges	5 in.
4		Standard W.I. washers	1½ in.

Nails, f.h.b. wood screws, cotter or wooden pins, washers ⅞-in., manila rope.



Lounge cart designed by G. A. Raeth, Glendale, Calif.

Procedure

1. Order all stock S4S and allow for dressing and waste. Lay out and cut seat rails.

2. Lay out contour lines on seat rails for the back rails J and the handle grips.

3. Cut out side back rails J with a rip saw or a band saw may be used for the whole cut. The end curve may be cut with the aid of a compass or turning saw if done by hand.

4. The handle parts are cut on a band saw or with the aid of a rip saw, compass or turning saw. Finish the rounded ends with a spokeshave, file, and sandpaper.

5. Lay out and cut the end seat rail *D*, and the cross rail *C*.

6. Lay out and cut the end seat rail *B*.

7. Lay out and cut the end back rail K to 30-in. length.

8. Lay out the centers for the ½-in. rope. Locate holes 1¼ in. down from upper edges on seat rails *A1* and *A2*, end seat rail B, the side back rails *J* and the end back rail *K*. Bore the ½-in. holes about 4 inches apart.

9. Assemble the side, cross and end rails with nails, or screws. The drawing shows the use of screws. Bore and countersink all holes for screws. Screw the end back rail K to the side back rails *J*. (Set the latter frame aside.)

10. Lay out and cut the notched strips *N* to 21-in. length. Cut 1-in. notches 1 in. apart as shown.

11. Screw the notched strips *N* in place.

12. Lay out and cut wheel brackets *E* to 10-in. length. See detail. Bore holes in the wheel brackets for the end of axle *F* and for the ½-in. bolts.

13. Lay out and cut the axle *F* to 40-in. length. Make axle of hardwood if possible. Shape the ends by hand or on a lathe to fit the holes in the wheel brackets.

14. Lay out and cut the legs *G* to 8½-in. length.

15. Lay out and cut the brackets *L* to 6-in. length.

16. Bore and countersink screw holes in legs *G* and brackets *L*.

17. Bore holes in side seat rails *A* for ½-in. hex. head bolts. Counterbore holes to bring the boltheads flush to top of side rails.

18. Round all corners and sand all parts. Round and sand corners well on handle grips.

19. Slip wheel brackets *E* on axle *F*.

20. Bolt wheel brackets *E* to side seat rails *A1* and *A2*.

21. Fasten legs *G* and brackets *L* in place. The legs *G* might be further secured at the top with dowel pins.

22. Lay out and cut the wheels *H* to 9-in. diameter. Bore holes in the wheels to fit the ends of the axle. Wheels may be cut on band saw or turned on lathe. When made by hand use a compass or turning saw, spokeshave, file and sand well. Round the corners.

23. Slip wheels and washers on axle *F* to determine location of pin on end of axle. Remove wheels and washers. Bore holes for dowel pins or cotter pins in axle *F*.

24. Fasten washers and wheels *H* to axle *F*.

25. Lay out and cut back braces *M* to 14-in. length. Round the upper ends and cut miters on lower ends.

26. Locate centers and bore holes for ⅝-in. dowel and ⅜-in. bolts on back braces *M*.

27. Cut ⅝-in. dowel rod *O* to 30-in. length.

28. Assemble back braces *M* to dowel rod *O*. Fasten dowel rod in place on ends to back braces *M* with brads.

29. Locate centers and bore holes for ⅜-in. bolt holes in side back rails *J* for fastening back braces *M* in place. Test position for braces *M*. The ⅜-in. bolt holes may be bored about 10 ½ in. to 12 ½ in. from the rounded ends of side back rails *J*. Bolt braces *M* to side back rails *J*.

30. Check all parts. Be sure corners have been rounded to about ¼-in. radius and well sanded.

31. Attach 5-in. strap hinges to side back rails *J* and side seat rails *A1* and *A2* as shown. The back rest can now be let down to a horizontal position or inclined as desired.

32. Attach and weave the ½-in. rope through the holes.

33. Before attaching ropes finish the cart as desired with linseed oil or in an amber or honey color with the aid of colors ground in oil. A coat or two of spar or marine varnish, or a good varnish finished dull, will preserve the color and wood.

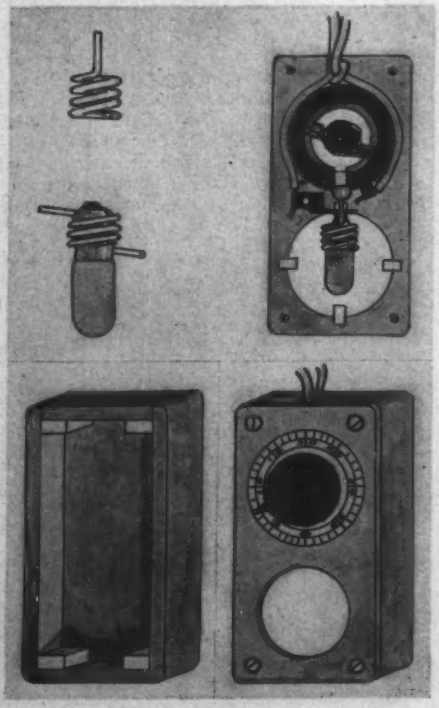
AN EASILY BUILT ENLARGING METER

W. H. HEGEMAN
Waukon, Iowa

A most satisfactory enlarging meter can be built by the average photographic fan for approximately a dollar. It does away with making test strips and gives exact enlarging time for any negative. Here is a list of the materials required:

No. of pcs.	*Part*	*Material*	*Size*
2	Top and bottom of meter	Masonite	2 x 4 in.
2	Sides	Masonite	⅜ x 4 in.
2	Ends	Masonite	⅜ x 1¾ in.
4	Corner posts	Soft pine	⅜ in. square x ⅞ in.
1	filament rheostat		
1	6-volt radio dial bulb, frosted		
4	small wood screws		
1	small piece of copper wire to form a bulb socket		

The filament rheostat was, in my case, bought secondhand from a radio shop for 15 cents. The dial bulb cost 10 cents, and more than enough Masonite came from a handy man's shop for another dime.



Enlarging meter

First, assemble the sides and ends with their corner posts. Glue and brad together. Then glue and brad the bottom piece and the case is finished.

The center of the diaphragm hole is 1 in. from the end of the lid. This opening is 1¼ in., and is cut with a wood bit. The diaphragm is made of heavy white bond paper, cut in a circle, 1¾ in. in diameter. The *grease spot* is made by placing a bit of paraffin, no larger than a grain of sand, in the center of the diaphragm and warming it over an electric bulb. It will make a spot about ⅛ in. in diameter. This paper is then attached to the underside of the diaphragm opening with four strips of adhesive tape.

A socket for the radio dial bulb is made by bending the copper wire, which is about the thickness of a hairpin, around the threaded portion of the bulb, as shown in the illustration. This is then soldered to the rheostat as shown. The rheostat is mounted so that the bulb will be approximately centered under the grease spot.

Now dip the frosted bulb in black paint and wipe off the excess. This leaves the bulb a very dark gray, which cuts down the light and makes the light match the negative color.

The scale under the rheostat knob is drawn on white paper and divided exactly as illustrated. The pointer is a piece of stiff black cardboard, glued to the underside of the knob so that it will point to zero when all resistance is out.

Enlargers are of two kinds — those using a 110-volt bulb for a light source and those that have a transformer cutting the current to 6 volts and using a 50 c.p. auto bulb for illumination. In the latter, the meter may be attached directly to the 6-volt side of the transformer. In the enlargers using the 110-volt bulb, it is necessary to connect a transformer to the line for use with the meter. An ordinary electric bell transformer can be bought cheaply in most variety stores and will serve perfectly.

To use the meter, let us suppose you have a negative in your enlarger and you have determined by previous experiment that 15 minutes' exposure will be required on the particular paper you are using, to make a perfect enlargement. Now place the meter on the easel so that the grease spot is in the densest part of the image. Adjust the rheostat until the grease spot just disappears. If the pointer stands at 30, for instance, let it remain there. Place another negative in the enlarger. The grease spot will now be brighter or darker than the densest portion.

Adjust the light of the enlarger now, by opening or closing the diaphragm of the lens until the spot disappears. The exposure time for this negative will now be 15 seconds. In other words, by leaving the meter at 30 and adjusting the light of the enlarger for all negatives until the spot disappears, you will be given an exposure time of 15 seconds for all negatives.

On the other hand, if you wish to calibrate your meter to read seconds of exposure time, this can be done by leaving the scale undivided and, by experiment, marking the time on the scale in seconds.

Sixty-two per cent of the bicycle riders injured in motor vehicle-bicycle accidents in 1944 were children between the ages of 5 and 14 years. — *Safety News.*

Lounge cart designed by G. A. Raeth, Glendale, Calif.

USES OF ANIMAL GLUE

The users of animal glue read like a *Blue Book* of American industry. The general public knows glue mostly as a woodworking adhesive. However, more than three quarters of the animal glue produced today is used for purposes outside of the woodworking field. Important base uses are: binder, sizings, and colloids.

As adhesives or binders, animal glues have long been used with paper, wood, leather, fiber, felt, and similar materials. Manufacturers of such products as musical instruments, coated abrasives, luggage, paper containers, matches, and gummed paper products take advantage of animal glue's ability to adapt to different use conditions and its durability. Animal glue-bound books from the public libraries have circulated without a break for fifty years. Violins of the old masters reproduce perfect tones after 300 years of use; animal glues hold them together and season the voice box. A wooden trunk taken from the tomb of an ancient Egyptian Pharoah reveals perfect glue joints after more than thirty centuries.

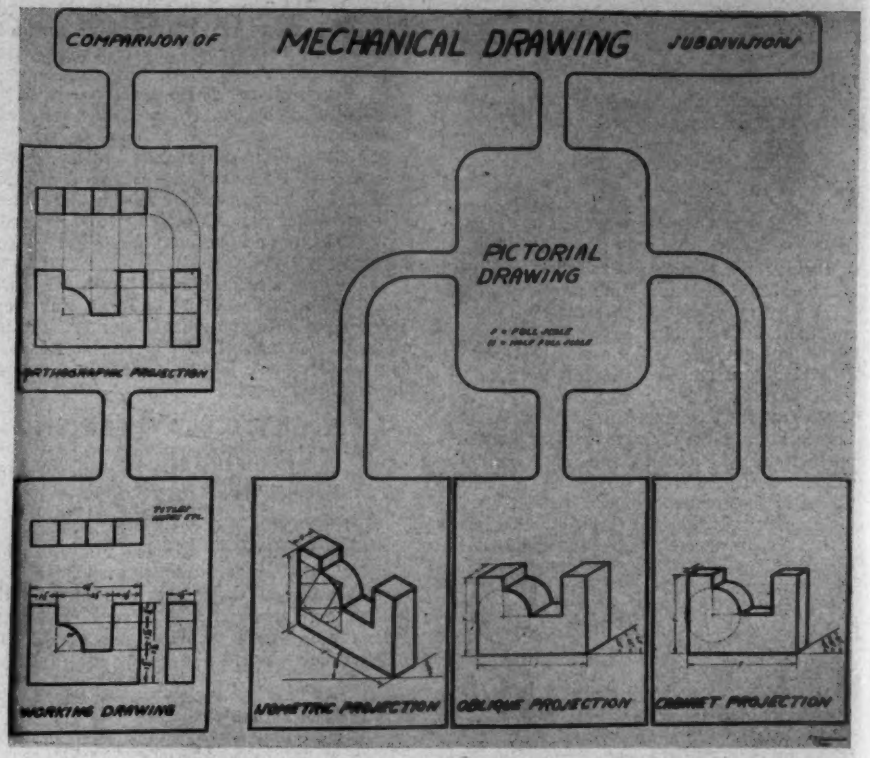
For sizings and coatings, millions of pounds of animal glue are used each year. Protective coatings are applied to textiles, paper, floor coverings, packaging and gasket materials. Synthetic rayon yarns, devoid of natural oils, require sizing with animal glue to prevent abrasion or chafing at the looms. Glue coatings are used on finished silks, rayons, cottons, and wools as splashproof finishes, to stiffen the fabrics, and to aid in dye leveling. Bond, writing, ledger, and currency papers are sized with glue to withstand wear, resist water and ink, and to facilitate erasure. Twisted paper, sized with glue, makes strong reed furniture.

Animal glue has great miscibility, mixing readily with such materials as clay, sand, and sawdust. The head of a match is a combination of glue, igniting materials, and other substances. Similar applications are found in doll composition heads, frescoes, wood, and cork compositions. Composition cork is made of ground cork, glue, and glycerine, and is used for gaskets, washers, insulation, and food container closures.

As a colloidal gel, glue is used in such products as printing rollers, shoe polishes, and hectograph plates. The printing roller, a glue glycerine combination, is a pliable yet durable solid solution that transfers printing ink from the fountain to the type form. The pliable surface of the roller allows for uniform pressure to be exerted on the irregular surfaces of the form. Essential to book, magazine, and job printing, the glue glycerine roller is also used in roller coating, textile printing, and in transferring impressions to metal surfaces for autos, pullman cars, and stoves. As a colloidal gel, animal glue has also been used in the development of many synthetic items to replace silks, ivory, marble, etc.

Useful also as protective colloids, animal glues are valuable in electrometallurgic processes. Addition of glue prevents crystallization and makes for smooth hard deposits of silver, tin, and copper. Glue is also used in acid pickle baths where the scale is removed from iron and steel prior to galvanizing. Rubber compounds, India ink, and fire-extinguishing substances also make use of the colloid nature of animal glue.—National Association of Glue Manufacturers, Inc., New York City.

Eighteen per cent of home accident fatalities were children under five years of age during 1944. — *Safety News.*



A chart showing the different types of mechanical drawings

SOLUTION TO INK TROUBLES

B. H. THOMAS
Central High School
Oklahoma City, Okla.

Some time ago I read where some fellow obtained a C-1060 screw-handle type Alemite grease gun, screwed an ordinary gas cock on the end, and filled it with printing ink.

I did just that and presto, my ink troubles were over. For printing teachers it is a solution to one of the problems that causes a great deal of trouble — cans left open, lid and can smeared with dried ink, ink dried and unusable, and the like.

We now have such a gun at each one of our platen presses. Hanger brackets for the guns were made out of strips of sheet metal about 1 in. wide. The guns hang just above the floor on the front of the presses. We rounded off the end of the gas nozzles on the lathe before installing them.

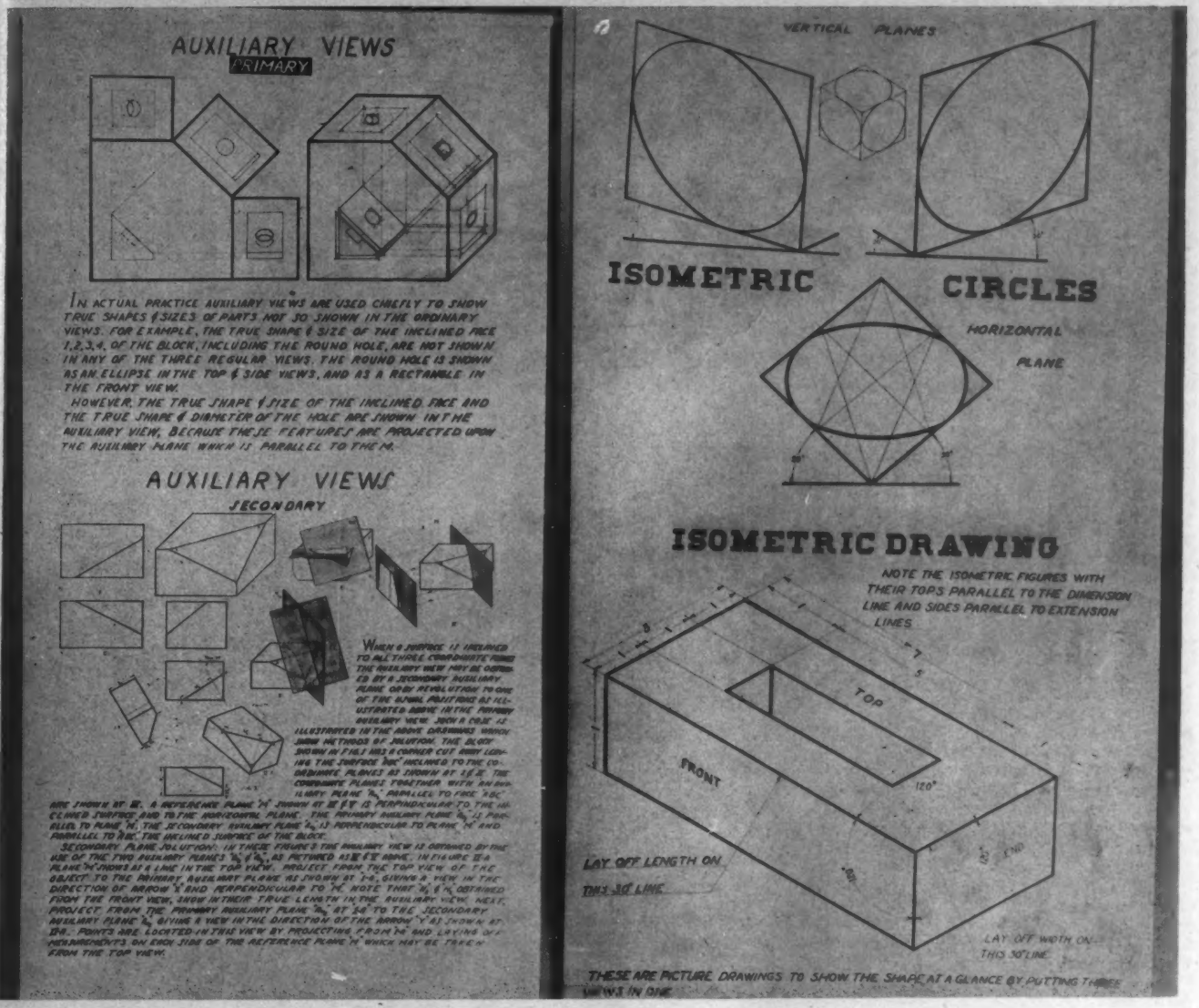
HELPFUL VISUAL AIDS FOR TEACHING DRAFTING

F. N. NEWTON, JR.

Supervisor of Industrial Education
Sharon, Pa.

It has always been my opinion that many drafting teachers both in high school and technical schools have not placed enough emphasis on lectures and demonstrations. To prepare such lessons and demonstrations properly, it requires considerable work and ingenuity on the part of the instructor, and

Transparent models for the drafting room


AUXILIARY VIEWS
PRIMARY
IN ACTUAL PRACTICE AUXILIARY VIEWS ARE USED CHIEFLY TO SHOW TRUE SHAPES & SIZES OF PARTS NOT SO SHOWN IN THE ORDINARY VIEWS. FOR EXAMPLE, THE TRUE SHAPE & SIZE OF THE INCLINED FACE 1,2,3,4, OF THE BLOCK, INCLUDING THE ROUND HOLE, ARE NOT SHOWN IN ANY OF THE THREE REGULAR VIEWS. THE ROUND HOLE IS SHOWN AS AN ELLIPSE IN THE TOP & SIDE VIEWS, AND AS A RECTANGLE IN THE FRONT VIEW.
HOWEVER, THE TRUE SHAPE & SIZE OF THE INCLINED FACE AND THE TRUE SHAPE & DIAMETER OF THE HOLE ARE SHOWN IN THE AUXILIARY VIEW, BECAUSE THESE FEATURES ARE PROJECTED UPON THE AUXILIARY PLANE WHICH IS PARALLEL TO THEM.
AUXILIARY VIEWS
SECONDARY
VERTICAL PLANES
ISOMETRIC CIRCLES
HORIZONTAL PLANE
ISOMETRIC DRAWING
NOTE THE ISOMETRIC FIGURES WITH THEIR TOPS PARALLEL TO THE DIMENSION LINE AND SIDES PARALLEL TO EXTENSION LINES
TOP
FRONT
120°
LAY OFF LENGTH ON THIS 30° LINE
LAY OFF WIDTH ON THIS 30° LINE
THESE ARE PICTURE DRAWINGS TO SHOW THE SHAPE AT A GLANCE BY PUTTING THREE VIEWS IN ONE

Auxiliary views and isometric drawing charts

as there are so many phases of the subject it is necessary to prepare quite a lengthy program. These programs should be worked up and studied so they can be presented without a hitch on the part of the instructor.

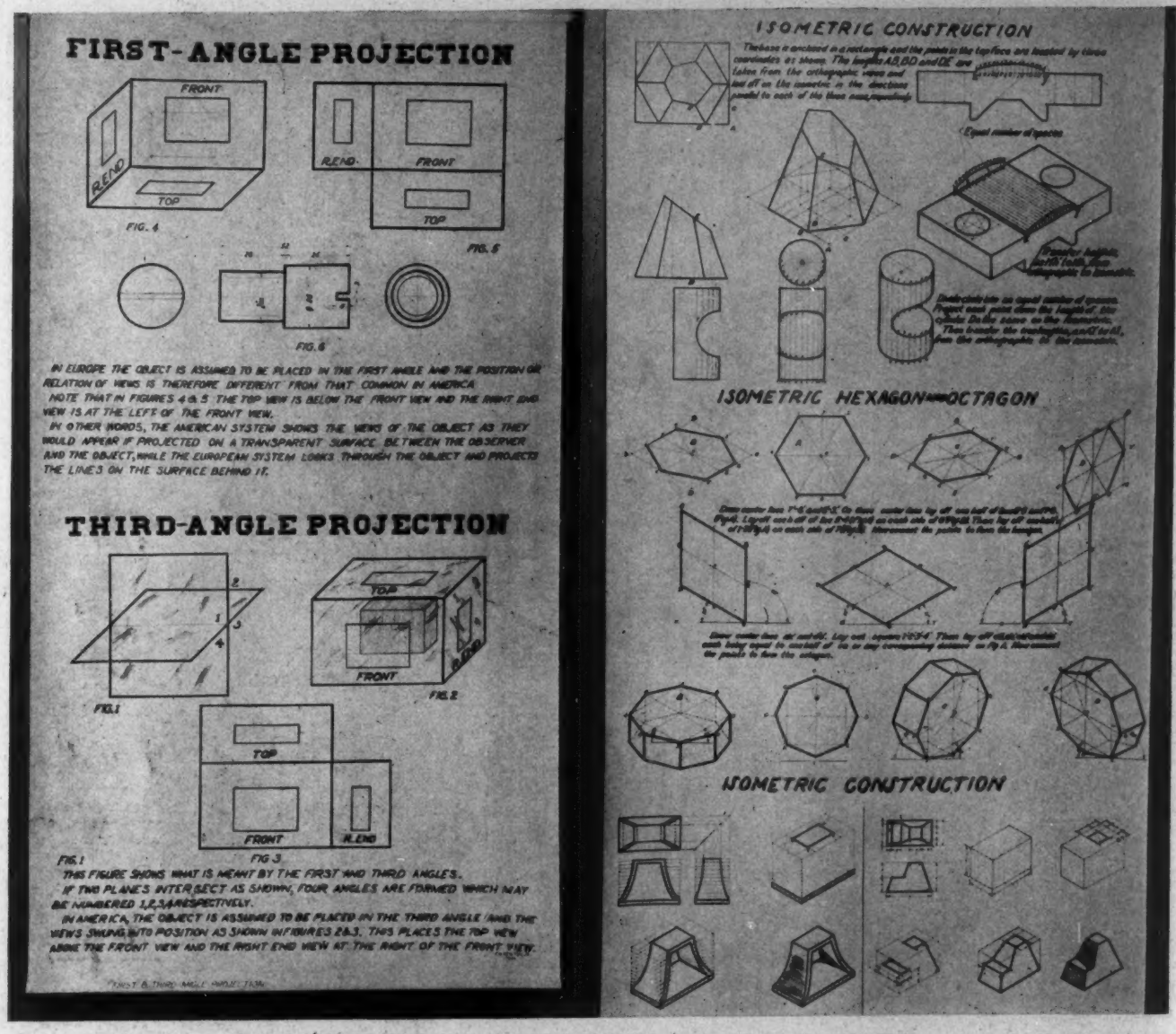
Now, especially, and without doubt for some years after the war there is going to be a great demand and need for boys who are well trained in our high schools in the fundamentals of drafting. Military genius has discovered that men in the various services can be trained faster and better through visual education than by the older methods used in past wars. The Armored Force School at Fort Knox, Ky., is a good example, for at this school men are taught the rudiments and principles of their military duties by the use of pictures, charts, drawings, and actual models.

Many of the writer's former students, returning on furlough, have informed him that the drafting which they acquired in high school has been of inestimable value, and that they were able to grasp the ideas presented in their service lectures much faster than boys who had no such high school training. In many instances it won for some of the students earlier advancement in rank.

This article is being written in the hope that it will help teachers in the field of drafting who are using no prescribed program in presenting their subject and will possibly eliminate some of the trials and tribulations that the writer experienced before he felt that he had worked out a program that really achieved results.

It is quite difficult to draw good demonstration material on the blackboard so that it looks well balanced from all parts of the drafting room, and to be effective all demonstration and lecture material used in a visual way must be visible from all parts of the room. To overcome this, large drawings were made on tracing cloth and tracing paper, on all of the principal subdivisions of drafting. such as dimensioning, sections, auxiliary views. developments, intersections, scale reading, and the like. These drawings were made approximately a yard square and with object lines about ⅛ in. thick with lettering about ¾ in. high. They were, therefore, easy to read from all parts of the drawing room. Blueprints of these tracings can then be fastened to the blackboard with Scotch tape a short time before a demonstration and lecture is to be given. After the demonstration the prints may be left on the board for the rest of the day so that the students can look them over and study them at their leisure. It is not wise to leave them on display too long, for by so doing, they lose their effectiveness as a teaching aid.

There is one disadvantage with the procedure just described, and that is that the Scotch tape looks rather unsightly, and that at times does not act any too well in holding the blueprint to the blackboard. To overcome this defect the writer bought some light gray blinds of good quality. These were a yard wide and two yards long. Upon these he transferred the drawings from the blueprints, using carbon paper for the purpose. It is not advisable to try to make the drawings directly on the blinds for it is not easy to erase any mistakes that may be made. A blackboard eraser well supplied with chalk dust was rubbed over the lines and the lines were then inked the same width of the lines as on the


FIRST-ANGLE PROJECTION
FRONT
R.END
TOP
FIG. 4
FIG. 5
FIG. 6
IN EUROPE THE OBJECT IS ASSUMED TO BE PLACED IN THE FIRST ANGLE AND THE POSITION OR RELATION OF VIEWS IS THEREFORE DIFFERENT FROM THAT COMMON IN AMERICA.
NOTE THAT IN FIGURES 4 & 5 THE TOP VIEW IS BELOW THE FRONT VIEW AND THE RIGHT END VIEW IS AT THE LEFT OF THE FRONT VIEW.
IN OTHER WORDS, THE AMERICAN SYSTEM SHOWS THE VIEWS OF THE OBJECT AS THEY WOULD APPEAR IF PROJECTED ON A TRANSPARENT SURFACE BETWEEN THE OBSERVER AND THE OBJECT, WHILE THE EUROPEAN SYSTEM LOOKS THROUGH THE OBJECT AND PROJECTS THE LINES ON THE SURFACE BEHIND IT.
THIRD-ANGLE PROJECTION
TOP
FRONT
R.END
FIG. 1
FIG. 2
FIG. 3
THIS FIGURE SHOWS WHAT IS MEANT BY THE FIRST AND THIRD ANGLES.
IF TWO PLANES INTERSECT AS SHOWN, FOUR ANGLES ARE FORMED WHICH MAY BE NUMBERED 1,2,3,4 RESPECTIVELY.
IN AMERICA, THE OBJECT IS ASSUMED TO BE PLACED IN THE THIRD ANGLE AND THE VIEWS SWUNG INTO POSITION AS SHOWN IN FIGURES 2 & 3. THIS PLACES THE TOP VIEW ABOVE THE FRONT VIEW AND THE RIGHT END VIEW AT THE RIGHT OF THE FRONT VIEW.
ISOMETRIC CONSTRUCTION
ISOMETRIC HEXAGON AND OCTAGON
ISOMETRIC CONSTRUCTION

First and third angle projection and isometric construction charts

blueprints. On some of the drawings colored India inks were used, especially for construction lines. This was found to make the drawings more attractive and in some cases more easily read. The chalk dust was then rubbed off with a clean cloth.

Two sets of brackets, which were supplied with the blinds, were then fastened to the top of the molding board at the top of the blackboard. All that was necessary then when a demonstration was required was to put the proper blind on the brackets and pull it down. This was found to be very satisfactory and only a minute was required to put the blind up and take it down. On the bottom of each blind was lettered the name of the demonstration outlined upon it; hence it is not necessary to unwind any of the rollers to see what they contain.

Along with the use of the blinds various transparent models were also used in the demonstrations.

While the constructing of the drawings and models takes time, thought, and energy, they will be found exceedingly useful and helpful.

SEWANHAKA AND THE HARVARD REPORT ON GENERAL EDUCATION

HUGH FLAHERTY
Vocational Director
Sewanhaka High School
Floral Park, N. Y.

Published at a time when this community (Floral Park, N. Y.) is formulating plans to meet the problem of a growing secondary school population in the years ahead, the Harvard report titled "General Education in a Free Society" should be required reading for every layman and teacher who will have a voice in deciding what course the proposed Sewanhaka building program should take. The result of two years and $60,000 worth of study, research, and consultation by a committee of 12 eminent Harvard scholars, it finds our secondary schools dangerously delinquent in the task of preserving democracy because of their failure to perpetuate a common body of tradition and culture. The inevitable result is a society of separate groups — isolated, divided, thinking and acting in terms of their own special interests — when the crying need of the nation and of the world is for unity.

The document is an eloquent espousal of the educational possibilities of the comprehensive high school such as Sewanhaka in which general education and vocational education may complement each other. As such it is a salute to the vision and courage of members of the Sewanhaka board and administration, past and present, who had the foresight to develop a program so closely approximating the ideal now presented by this distinguished committee.

For the home economics, industrial arts, and vocational groups who have long been making their way alone through a miasma

(Continued on page 22A)

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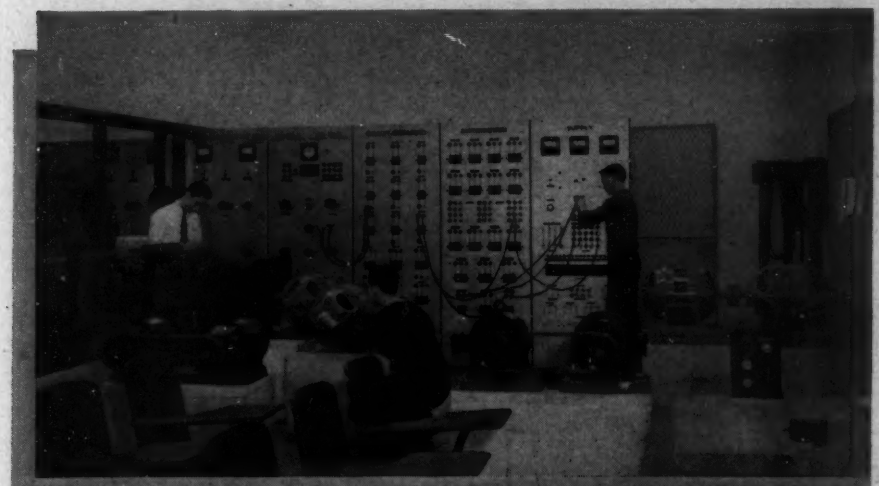

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THE STANDARD ELECTRIC TIME CO., SPRINGFIELD 2, MASS.
Founded 1884

(Continued from page 146)

of educational ignorance, indifference, and snobbery, the Harvard pronouncements are as a shaft from Olympia. Coming from an institution of learning popularly regarded as the very citadel of Brahmanism, the report will be accorded a respectful hearing even in those educational and lay circles which still blindly pursue the mirage of the classical curriculum as the alpha and omega of education.

The number of persons under 25 years old who are drowned each year is the equivalent of the normal complement of 30 U. S. Navy destroyers. — *Safety News.*

Personal News

FERN NAMED MANAGING EDITOR

George H. Fern has been named managing editor of the *American Vocational Journal* by joint action of the Executive Committee of the *American Vocational Association* and *Scholastic* magazines.

Mr. Fern, formerly state director of vocational education in Texas and Michigan, brings to the managing editorship more than 25 years' experience covering all fields of vocational education. During the war years he was also state Director of War Production Worker Training, and Food Production Training in Michigan. Mr. Fern has been editor of *Industrial Education News* in Texas and the *Michigan Vocational Outlook*. Just before entering his new work he served as chief of the Training Branch, Civilian Personnel Division, Office of the Secretary of War. Mr. Fern is American Vocational Association vice-president for industrial education and author of "What is Vocational Education," "Training for Supervision in Industry," and co-author of "Teaching with Films."

Mr. Fern's offices will be in the AVA headquarters at 1010 Vermont Avenue, Washington 5, D. C. Production and advertising headquarters will continue at 220 East 42nd Street, New York 17, N. Y.

JOINS UNIVERSITY OF MICHIGAN

Lt. Colonel Wenrich has joined the industrial teacher training staff of the University of Michigan, Ann Arbor, Mich.

He is a native of Lebanon, Pa., and was graduated from the high school of that city in 1926. He entered Pennsylvania State College, under Dr. F. Theodore Struck, head of the department of industrial education, and received his B.S. degree from this institution in 1931.

Lt. Colonel R. C. Wenrich

Continuing his studies under Drs. Struck, Friese, Dennis, and Cressman during summer sessions, earned him his M.S. in 1934.

He taught industrial-arts work at Quakertown, Pa., from 1931 to 1932; Reinerton, Pa., from 1932 to 1937; was supervisor of the vocational program at Quakertown, Pa., from 1937 to 1940; area co-ordinator, in-service teacher trainer, and supervisor of the T. & I. program at Pennsylvania State College, State College, Pa.; administered and supervised the state program of industrial education from 1941 to 1942.

He joined the armed forces in 1942 and has just finished his last assignment which consisted of organizing and developing the Surgeon General's program for reconditioning in convalescent hospitals.

He has done considerable professional writing and has had articles published in the *American Vocational Association Journal, Industrial Arts and Vocational Education, Michigan Vocational Outlook, Occupations,* and *School Shop.*

DR. ROYAL B. FARNUM RETIRES

Dr. Royal B. Farnum, director of art education, and executive vice-president of the Rhode Island School of Design, Providence, R. I., will retire July 1, 1946.

Dr. Farnum is a native of Somerville, Mass., and attended the public school there. He was graduated from the Massachusetts Normal Art School in 1906. He received a master of education degree from the Cleveland School of Art in 1929. He also made many trips to Europe on study tours.

He came to the Rhode Island School of Design in 1929 from Boston, where he was state director

(Continued on page 24A)

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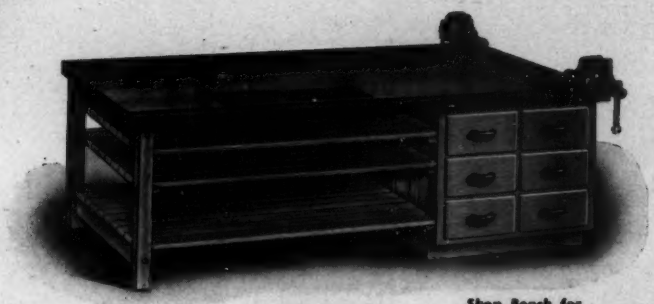

Shop Bench for Metal Working

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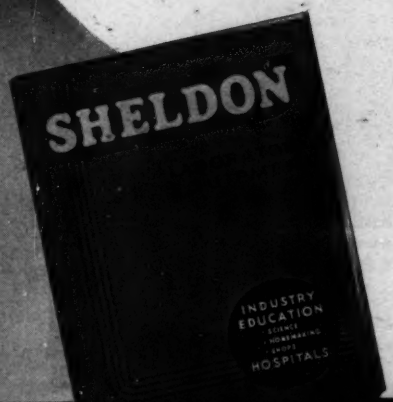

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MUSKEGON, MICHIGAN

(Continued from page 22A)

of art education for Massachusetts, and principal of the Massachusetts School of Art.

He is a fellow of the Royal Society of Art, London, former chairman of the American Delegates to three international art conferences, former art adviser to Carnegie Group, a member of Teaching Film Custodians, Chairman of the Rhode Island Commission to the New York World's Fair, and a member of the National Education Association. A prolific writer on art education topics, Dr. Farnum has contributed to the *School Arts* magazine, *Industrial Arts* magazine, *Educational Review*, the *Journal of the National Education Association*, the magazine *Education*, and other publications.

APPOINTED ASSISTANT DIRECTOR OF VOCATIONAL EDUCATION

J. Warren Smith, professor of industrial education, and formerly director of the program of vocational training for War Production Workers for the State Department of Public Instruction, Raleigh, N. C., has been appointed assistant director of the division of vocational education. Mr. Smith will continue his present relationship at the North Carolina State College of Agriculture and Engineering, and will assist Mr. T. E. Browne, director of the division, in the administration and supervision of the total program of vocational education.

Mr. Smith comes to his new appointment with a broad experience in the field of vocational education. His experience includes prior positions in North Carolina as teacher of industrial education in the Raleigh High School, city director of vocational education for the Winston-Salem City Schools, educational director of the Champion Paper and Fiber Company and the American Enka Corporation, state supervisor of apprentice training, and assistant state supervisor of industrial education.

Mr. Smith is a graduate of Miami University (Ohio) with a M.S. degree from Columbia University.—*J. K. Coggin.*

ALLEN BACKUS DIES

Allen D. Backus, director of practical arts, Newark, N. J., died at the age of 54 on December, 19, 1945, at his home in East Orange, N. J.

Mr. Backus began his teaching career in 1907 at Sidney, N. Y. He also taught at Salt Lake City, Utah, Scottdale, Pa., and Oneonta, N. Y., before coming to Newark in 1913.

He received his B.S. degree from the Rutgers University School of Education in 1932, and his master's degree from the same institution in 1938.

He also attended The Pratt Institute, the Delaware Literary Institute, and Columbia University, New York, and lectured on education in the New York University School of Education for some time.

He was a member of the American Industrial Arts Association, the Newark Industrial Arts Teacher's Association, Epsilon Pi Tau, National Education Association, Newark Teacher's Association, Phi Delta Kappa, the Newark Schoolmen's Club, and State Supervisor's Association.

Mr. Backus also was a contributor to the professional literature of his field.

♦ FELIX EUGENE AVERILL, senior specialist in supervisor and teacher training, trade and industrial education service, Vocational Division, U. S. Office of Education, died November 10, 1945, at his home in Kensington, Md. Mr. Averill had served the U. S. Office of Education since 1939.

♦ LT. COMDR. JAMES R. COXEN, USNR, recently released from active duty with the navy, has returned to the U. S. Office of Education, Vocational Division, as chief of the research and statistical service. Joining the federal board for vocational education in 1929 as regional agent for trade and industrial education, Lt. Comdr. Coxen served one year as acting chief of trade and industrial education service. At the time of his entrance into the navy, he was consultant in public service training. Mr. Coxen is a native of Kansas, and a graduate of Kansas State College, Manhattan.

♦ W. A. ROSS has been appointed consultant in public service occupations, vocational education division, U. S. Office of Education, the position in which he has been serving in an acting capacity since January, 1943. Joining the staff of the federal board for vocational education in 1929, Mr. Ross served as subject matter specialist in the agricultural education service and as national executive secretary of the Future Farmers of America until 1943. Mr. Ross is the author of several books and bulletins on vocational education.

♦ JAMES A. BAILEY, formerly instructor of vocational agriculture at Salisbury, Mo., has joined the vocational agriculture division as district supervisor of the Northwest Missouri district, Jefferson City, Mo.

♦ GORDON RENFROW, who was director of supervision in the Missouri State Department, until he entered the navy, has just returned from the service and has been appointed director of the division of Veterans' Education in the State Department of Education, Jefferson City, Mo.

♦ EDWARD F. WESTON succeeded Mr. Bootman as instructor of woodworking at Roosevelt High School, Des Moines, Iowa.

♦ EDGAR SWANSON has been appointed supervisor of Employment Service at Iowa State College, Ames, Iowa.

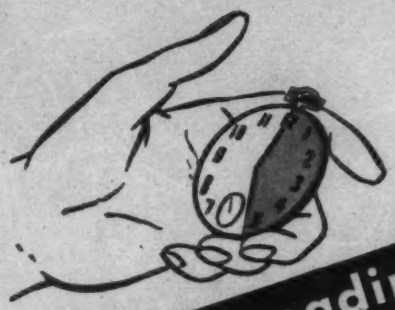
♦ FRANK L. JUDISH is the co-ordinator at the West Allis Vocational and Adult Education School, West Allis, Wis.

♦ ANDY ANDERSON has joined the faculty of the high school at Manchester, Iowa.

♦ D. M. BURKHISER, formerly an instructor at Washington Junior High School, Dubuque, Iowa, is now in charge of the industrial education work at the Chadron State Teachers College, Chadron, Neb.

♦ BOB HENNING, instructor in the Davenport industrial education department, was president of the newly reorganized Iowa Industrial Education Association during the past year.

(Continued on page 27A)



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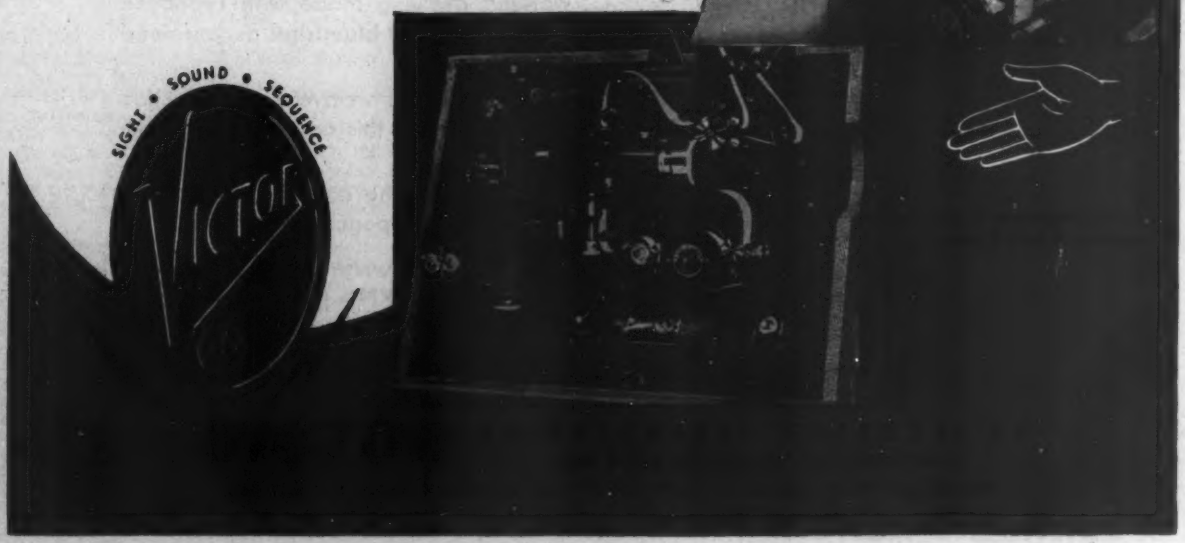

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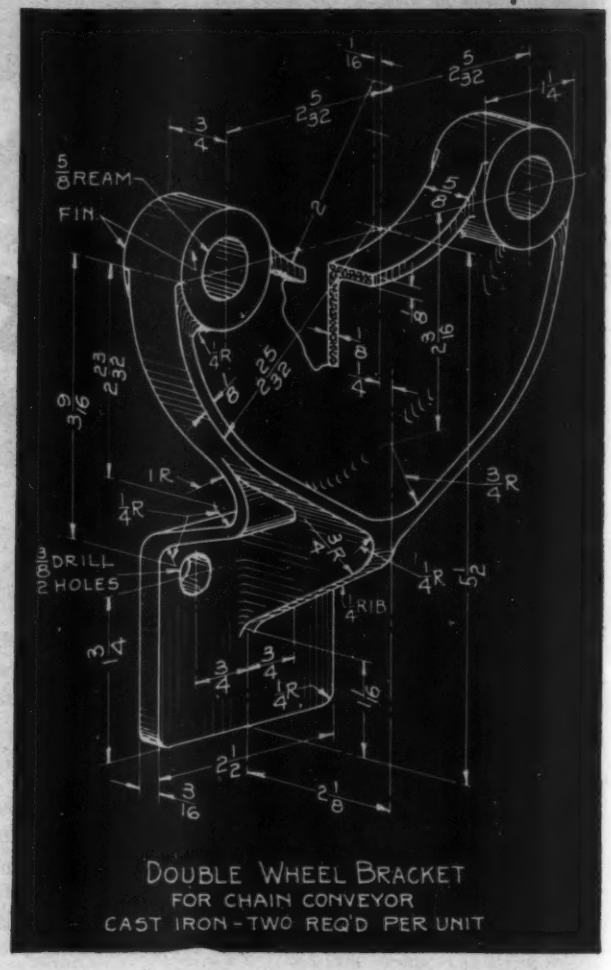

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(Continued from page 24A)

♦ MILTON MEULER, who teaches drawing in the Burlington, Iowa, High School and Junior College, is one of the newly elected directors of the Iowa Industrial Education Association.

♦ MR. R. WAYNE ADAMS, on leave from the department of industrial education, North Texas State Teachers College, and during the war a civilian specialist with the Instructor Training Department of the Armored School, Fort Knox, Ky., is now in attendance at the University of Missouri where he is working on his doctor's degree in industrial education.

♦ MR. ALFRED MOORE, formerly of Bowling Green, Ky., has been appointed head of the department of industrial education at the State Teachers College, Johnston City, Tenn. Mr. Moore completed his work for the master's degree in industrial education at the University of Missouri.

♦ MR. JOHN OWEN HARLAN of the Teachers College staff, Charleston, Ill., has been appointed part-time instructor of industrial education at the University of Missouri, where he is pursuing work toward his doctor's degree.

♦ H. C. HAWES has been appointed supervisor of the Ontario Training and Re-establishment Institute, the new school of graphic arts in Ontario, Canada.

He has just returned after having spent 4½ years as a member of the Canadian army, serving in Sicily, Italy, Belgium, Holland, and Germany.

Previous to the war he was printing instructor at the Wesdale Secondary School, Hamilton, Ontario, from 1935 to 1941.

♦ BERT H. MIZUHA, formerly at the Kawananakoa Intermediate School, has been transferred to McKinley High School, Honolulu, Hawaii.

♦ W. F. STEWART, College of Agriculture, Ohio State University, has been appointed chairman of the editorial advisory council of the American Vocational Association. Other members are JOHN A. MCCARTHY, assistant commissioner of education, New Jersey, and ANNA K. BANKS, chairman, home-economics department, New York University. All are AVA. vice-presidents.

♦ The following are contributing editors appointed by the American Vocational Association for the current year:

Agricultural Education — Carsie Hammonds, University of Kentucky, Lexington, Ky.

Business Education — M. A. Browning, State Board for Vocational Education, Austin, Texas.

Home Economics Education — Letitia Walsh, University of Illinois, Urbana, Ill.

Industrial Arts Education — E. E. Ericson, Santa Barbara College, Santa Barbara, Calif.

Industrial Education — H. M. Jellison, Board of Education, Akron, Ohio.

Part-Time Education — R. L. Welch, State Board of Vocational and Adult Education, Madison, Wis.

Vocational Guidance — C. E. Partch, Rutgers University, New Brunswick, N. J.

Vocational Rehabilitation — O. F. Wise, Court House, Birmingham, Ala.

♦ ALLEN BOLLER of Atlantic, Iowa, and M. E. EDWARDS, of Perry, Iowa, are directors in the Iowa Industrial Education Association. In addition, they are both serving on a special committee of the association to help promote district activities.

♦ RAY MCBURNEY has been appointed instructor of industrial arts in Central Junior High School, Ames, Iowa.

♦ R. R. PANNKUK is teaching industrial arts work in the Nevada Public Schools, Nevada, Iowa.

♦ DR. W. C. BICKNELL, formerly with Pratt-Whitney Aircraft Corporation, Kansas City, has returned to the University of Missouri campus, where he had been instructor of industrial arts in the University laboratory schools. In his new position he is to have charge of a trade training program of less than college grade for veterans. Dr. Bicknell received his advanced degree in industrial education at the University of Missouri in 1944.

♦ IVAN HOSTETLER completed the work for his doctor's degree in industrial education at the University of Missouri during the 1945 summer session, and has returned to Georgia Teachers College, Colleboro, Ga., as chairman of the division of fine and applied arts. During the war Dr. Hostetler served two and a half years as an instructor and foreman with Pratt-Whitney Aircraft Corporation of Kansas City, and while at Missouri he was a part-time teacher in industrial education.

♦ EDWARD G. SCHULTZ has been appointed director of guidance and visual education for the board of education at Fond du Lac, Wis.

It takes the average car traveling at 20 miles an hour 191 feet to stop on a road covered with glare ice. Chains on the rear wheels reduce this stopping distance to 110 feet, and chains on all four wheels allow the car to stop in 85 feet. — *Safety News.*

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Association News

♦ March 5–7. American Association of School Administrators at New York, N. Y. S. D. Shankland, 1201 16th St., N.W., Washington, D. C.

♦ March 12–14. American Association of School Administrators at Chicago, Ill. S. D. Shankland, 1201 16th St., N.W., Washington, D. C.

♦ March 5–7. American Educational Research Association at New York, N. Y. David Segel, secretary, U. S. Office of Education, Washington, D. C.

♦ March 12–14. American Educational Research Association at Chicago, Ill. David Segel, secretary, U. S. Office of Education, Washington, D. C.

(Continued on next page)

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have been designed for ready

Adaptability to a Wide Range of Projects

Thus, fewer machines are needed to meet all your requirements. Of

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you can plan more efficient layouts, without the waste of floor space necessary with larger equipment.

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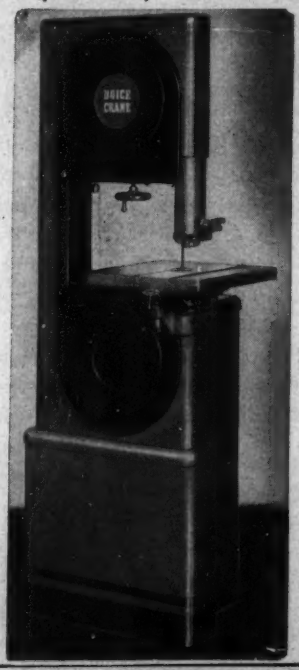

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(Continued from previous page)

♦ March 14–16. New Jersey Vocational and Arts Association at Atlantic City, N. J. J. J. Berilla, secretary, 549 Corliss Ave., Phillipsburg, N. J. Headquarters, Ambassador Hotel.

♦ March 18–30. Purdue Industrial Personnel Testing Institute at Purdue University, Lafayette, Ind.

♦ The Ship, which is an organization composed of representatives of reliable firms doing business in the educational field, and which is well known to those who attend the conventions of industrial arts and vocational education groups, announces the election of the following officers for the ensuing year:

Captain Al Opie, The O-P Craft Co., Inc., Sandusky, Ohio.

First Mate Bert Cholet, Higgins Ink Co., Inc., 271 Ninth St., Brooklyn 15, N. Y.

Second Mate John Backus, American Type Founders, 200 Elmora Ave., Elizabeth 3, N. J.

Log Officer, Charlie Stoner, C. Howard Hunt Pen Co., 7th State St., Camden, N. J.

Purser C. L. Messmore, International Textbook Co., 1001 Wyoming, Scranton 9, Pa.

Radio Officer Ernie Tresselt, Devoe & Raynolds Co., Inc., 44th St. and First Ave., New York, N. Y.

Steward Chuck Lyman, care of C. E. Lyman, Jr., 230 Guard St., Rockford, Ill.

SCHOOLS TO IMPROVE MANAGEMENT-LABOR RELATIONSHIPS

S. LEWIS LAND

Head, Department of Industrial Education

State College, Pennsylvania

In the first nine months of the year 1945, idleness due to strikes and lockouts in 2861 industrial and other establishments involved 1,682,000 workers and 17,593,000 man-days of idleness. This is equivalent to a loss of the production, over an entire year, in a plant employing approximately 8500 persons.

A long-range program, which it is believed will contribute much to an improved management-labor relationship is proposed here.

The so-called "employer-employee problem" has as its basis the apparent conflict which results from a desire on the part of the employee to secure (1) shorter working hours, (2) increased wages, and (3) improved working conditions, and a desire on the part of the employer to secure (1) increased worker efficiency, (2) greater productive output, and (3) quality workmanship. Any enduring solution to the problem must assure to each group the possibility of achievement of these objectives within the limits of fairness to the other group.

Contrary to the belief of many, there is no deep-rooted conflict between the objectives of the employer and the employee. The apparent conflict usually results from the means employed to achieve these objectives and not in the objectives themselves.

The basic interests of employer and employee are so inseparably bound together that in the final analysis what is sound for the one group is sound for the other group. With the recent rapid development of machine technology and the progress of science and invention, we have at our command all that is needed to assure to each group what it desires.

Mere statements of principles of ethics, the adoption of resolutions and the enactment of rules and regulations by legislation, however sound they may be, will not solve the problem nor can there be a solution which will achieve effective results overnight.

Any solution to be productive of long-enduring results will require time in its application, but the harvest of industrial good will, and the economic gains to accrue to both employer and employee will be well worth the effort.

A Five-Fold Solution

The basic solution of the problem is a fivefold one:

First, an improved industrial relationship between employer and employee must have its fundamental basis in wiser choice of lifework on the part of all young people. Factors which are important in this connection are one's native ability and equipment in terms of the demands of the wide variety of occupations from which the individual young person may choose, one's liking for the work involved in the occupation chosen, and one's ability to adequately prepare himself or herself for the successful pursuit of the chosen occupation.

Second, wise choice of lifework can contribute to the realization of all that is desired on the part of both employer and employee only if that choice is followed by adequate preparation. Fortunately there

(Continued on page 30A)

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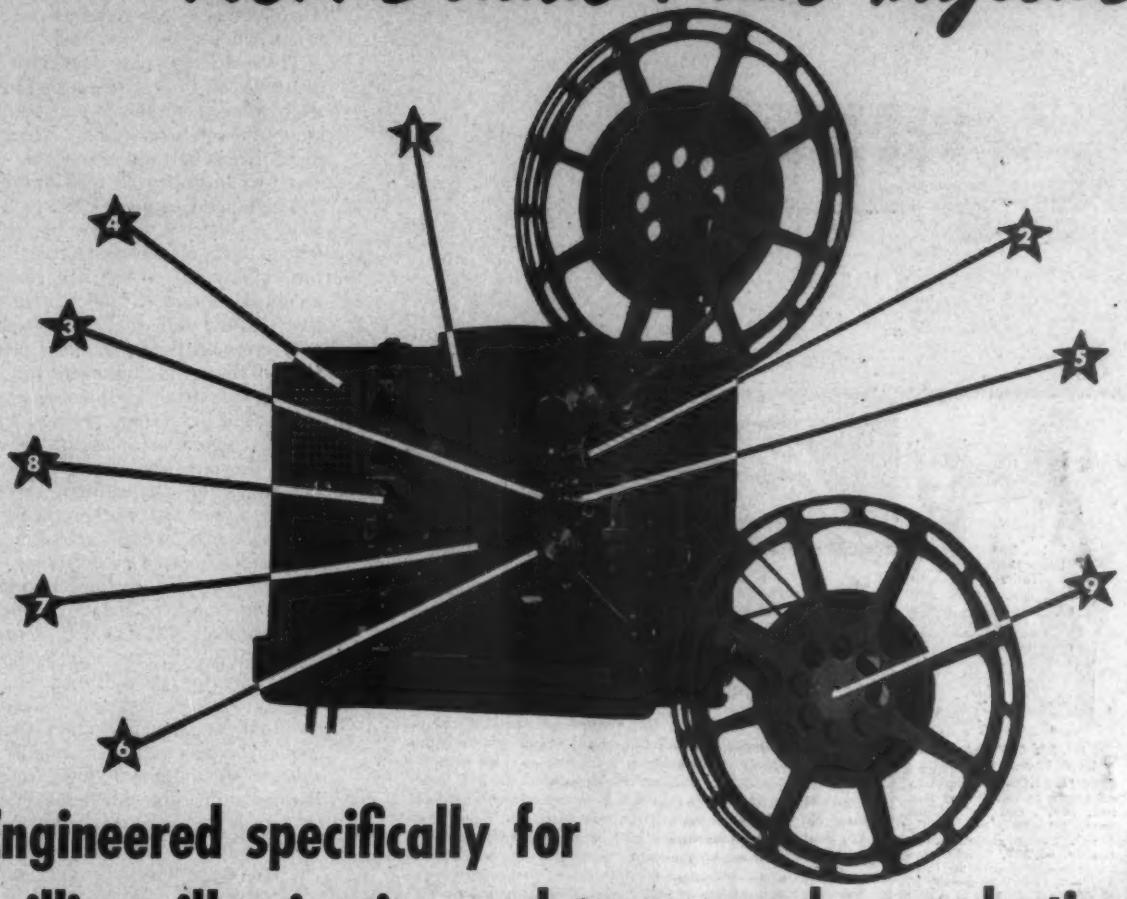

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For detailed information on the RCA Sound Film Projector, send for descriptive booklet. Write Educational Department, 40C Radio Corporation of America, RCA Victor Division, Camden, N. J.

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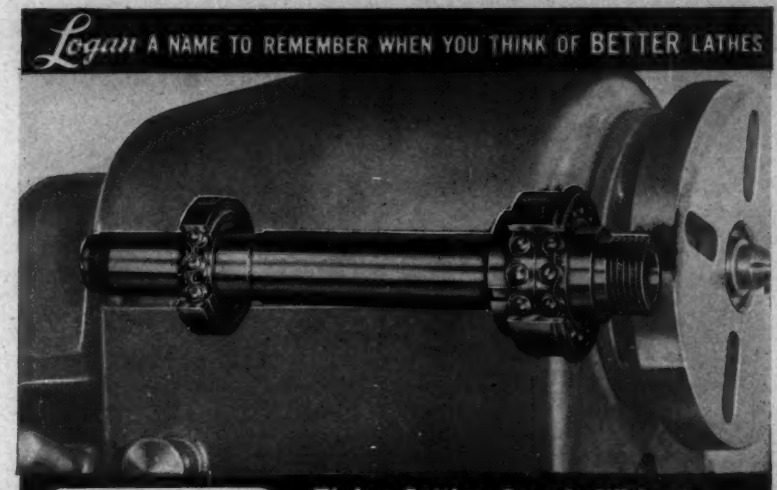

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(Continued from page 28A)

are ever increasing opportunities for thorough, basic, and sound preparation available to young people in an ever increasing range of occupations which will enable them to render most effective service to their employers, to their communities, and to themselves.

Third, it is important that there shall be work opportunities for young people who have wisely chosen lifework and who have had adequate training for the successful pursuit of those occupations. Although this is a social and economic problem which is of concern to the community as a whole, it is at the same time a problem which is of immediate and deep concern to employers individually and collectively. Young people must recognize that the securing of a job is their own responsibility. Yet they must have assistance from our public-school system, from our public employment service, and from employers generally in this very important undertaking.

Fourth, there must be opportunities for advancement and promotion consistent with the worker's ability to progress in his chosen occupation. This is definitely the responsibility of industrial management and represents a policy of enlightened self-interest. Such a sound personnel policy which provides for advancement based on merit and achievement contributes equally to the realization of the interests and desires of both the employer and the employee.

Fifth, there must be a *deep-seated* recognition on the part of both employer and employee that their interests are inseparably bound together and that each may have what is justly due him without in any way minimizing or jeopardizing the welfare of the other, but that to gain the objectives of either requires the intelligent co-operative effort of both.

These are the five important *stones* in the *arch* of improved industrial relationship between employer and employee. An industrial-relations policy which includes these five important *planks* will contribute much to an improved relationship between employer and employee and will pave the way for shorter working hours, increased wages, and improved working conditions for employees on the one hand and for increased worker efficiency, greater productive output, and quality workmanship for employers on the other hand. The translation of these five important policies into a sound industrial-relations program is the concern of both employer and employee as well as the public. Sound choice of lifework and adequate preparation for the chosen occupation are the ultimate responsibilities of the individual worker, but there must be assistance on the part of the employer and the schools. Getting a job is likewise the responsibility of the individual worker, but the employer must provide the work opportunity. Advancement is the definite responsibility of the individual worker, but provision for advancement in line with ability and achievement must be incorporated in the personnel program and policy of the employer. Finally, both employer and employee must recognize that he has ability to achieve his objectives only if he has the co-operation of the other and in turn be willing to lend his co-operation to the end that both may achieve their objectives.

INTERESTING THE STUDENT IN MECHANICAL DRAWING

WM. E. HUFF

Union High School

Los Gatos, Calif.

For a number of years we taught mechanical drawing by presenting the pupil with a series of easy, carefully graded exercises calculated to teach the essential techniques of the art. Then a beginning student asked for permission to draw the plans for a scale model airplane. After some hesitation, and with grave doubt as to the probable outcome, permission was given. Results in the case were not merely satisfactory, but they were phenomenal.

This student was so engrossed in his hobby of model airplanes that nothing but perfection in his drawings of these models would satisfy him. His work became neat and accurate. Poor lettering was a blow to his pride and he became interested in good lettering.

(Continued on page 32A)

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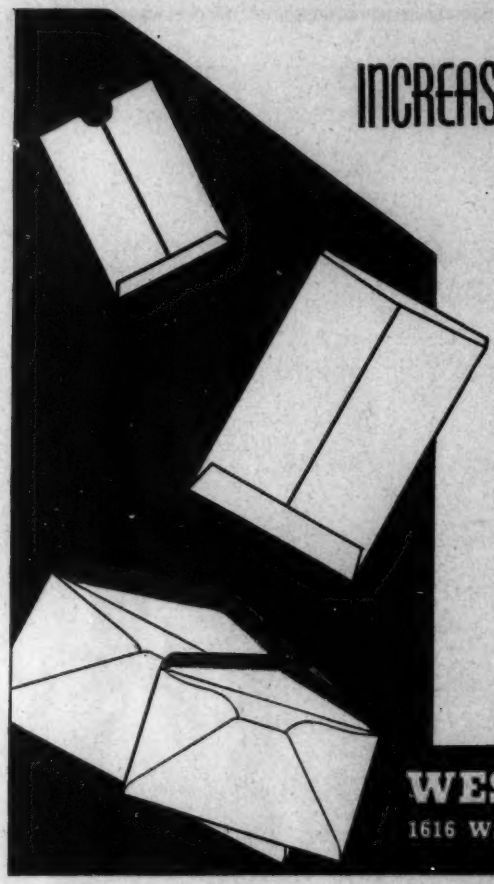

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(Continued from page 30A)

Many similar experiences since then have proved the feasibility of this method of teaching mechanical drawing. Now, as soon as a student has done enough plates to learn to use his instruments and to have an idea of orthographic projection, the pupil is encouraged to select a project for himself. The results in almost all cases have been gratifying. Interest is aroused and no trouble is experienced in giving the student a good course. If, for example, none of his projects touch on the subject of developments, he is usually quite willing to do a few plates in this field for the experience and the pleasure of trying something different.

PRACTICAL INTERDEPARTMENT CO-OPERATION

G. HAROLD BILLINGHAM
High School
Weehawken, N. J.

Electricity comes attractively packaged to the home, but unfortunately, there is a maintenance problem.

The *Family Relations* class, at the High School, Weehawken, N. J., under the direction of Miss Anna J. Arlinghaus, had developed to a point where a lesson on practical home mechanics would correlate with her course of study.

My advanced group, the *Industrial Practices class*, also met during the sixth period the same days.

After several conferences Miss Arlinghaus planned an attractive program for the boys based on the "Viewpoint of Woman in the Home," and we decided to exchange classes for one period.

The boys wore their individual blue shop aprons to the Foods and Clothing Department. The aprons added a business-like appearance, protected their clothes, and the name plates made introductions unnecessary.

After a brief resume of the procedure, and given the welcome information that they were to make chocolate drop cookies, the potential mechanics were divided into groups of three for the individual kitchens.

Instructions included safety factors involved in lighting an oven, handling heated accessories, and the notation that recipes are like chemical formulas. Measuring was demonstrated so that standard mixtures would evolve. Although blueprints were missing, the production was a grand success.

Some samples were eaten in class, while others found their way home as souvenirs of an invasion of women's territory. Like good housekeepers they followed through with dishpans, cleaning dishes and kitchens, realizing that this activity, although fun, was not in a play area.

Meanwhile, the girls, attractively attired in their aprons, started their quest for related electrical knowledge by grouping around a washing machine lying on its side on a portable workbench in our general shop. This critical laundry unit, a casualty due to lack of oil and dried out wiring insulation, had been fully reconditioned in the shop. Its previous condition was an excellent example to embryo housewives of the work value of a few drops of oil, and the importance of elementary wiring knowledge. The unorthodox position of the washing machine made it a valuable visual aid since the power plant could be readily seen, both in and out of action.

Typical lighting and bell wiring problems worked on displays designed and built by shop students, types of wire, practical testing devices, and a few trick effects were then shown in the electrical division. Special emphasis was placed on the fact that home electrical appliances in general are portable and need to be connected to an electrical source. The connections, either through wear or abuse are potential means of electrical failure, and are within the repair scope of the housewife.

Panels, wire, plugs, and other electrical necessities were afterward made available to the girls for actual practice. Especially prepared diagram sheets with a "Family Relations Class" heading were distributed for the prehookup, circuit approval. These were excellent materials for the souvenir collectors, besides having definite safety values.

Ernest Eagle *chases* GHOSTS!

DEMONS of the drawing board, these two little wraiths haunted draftsmen's dreams . . . 'til TURQUOISE took over.

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Somebody drew him, but he died. Burnt out in the intense glare of the printing machine, he became a pale shade of his former self . . . a here-again gone-again phantom that flits erratically across the prints. *But TURQUOISE lines stay put.* *Electronic graphite, super-refined in Eagle's patented Attrition Mill makes even the thinnest line so opaque and *solid* that it shows up . . . alive and hearty . . . on every print.

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PHOTOMACROSCOPY — A VISUAL AID FOR VOCATIONAL CLASSES

RICHARD H. BEHRENS
Berkeley, Calif.

The technology of trade and industrial processes are usually well understood in principle and in practice by the college trained engineer. The many hours he has spent in the science and engineering classrooms and laboratories has provided him with a considerable fund of knowledge which he is able to apply on the job. The vocational pupil, on the other hand, usually completes his formal preparatory trade or industrial training in the course of his high-school enrollment. This leaves him with but little time to acquire the technological "why" of his occupation, the lack of which often spells comparative success or failure in his chosen work. Technological instructional material for the vocational pupil must therefore be organized to fit his background and the limited period of time which he has to spend on this phase of his education.

Visual material can often be of great value in quickly presenting the vital knowledge necessary for the intelligent performance of the various fundamental jobs in his occupation. Of these visual aids, photomacroscopy, i.e. photography in magnifications of from 2 to about 10 degrees, can prove highly efficient in quickly illustrating the structural characteristics of materials of construction or the processes of fabricating them. Such visual aids, photographed under ideal conditions, with important structural details of the objects photographed accentuated, can be studied by a student group or class without the limitations imposed by the unaided eye.

A variety of cameras may be adapted to macrophotography, ranging from the miniature to the larger plate or cut-film back types. Of these, the cameras equipped with ground glass focusing screens and a bellows-draw double that of the focal length of the lens used are the most adaptable. Photography with the bellows fully extended makes full size pictures possible. With such cameras, pictures made on fine-grained film and developed in fine-grain developer may be enlarged from 10 to 15 times with no material loss in sharpness.

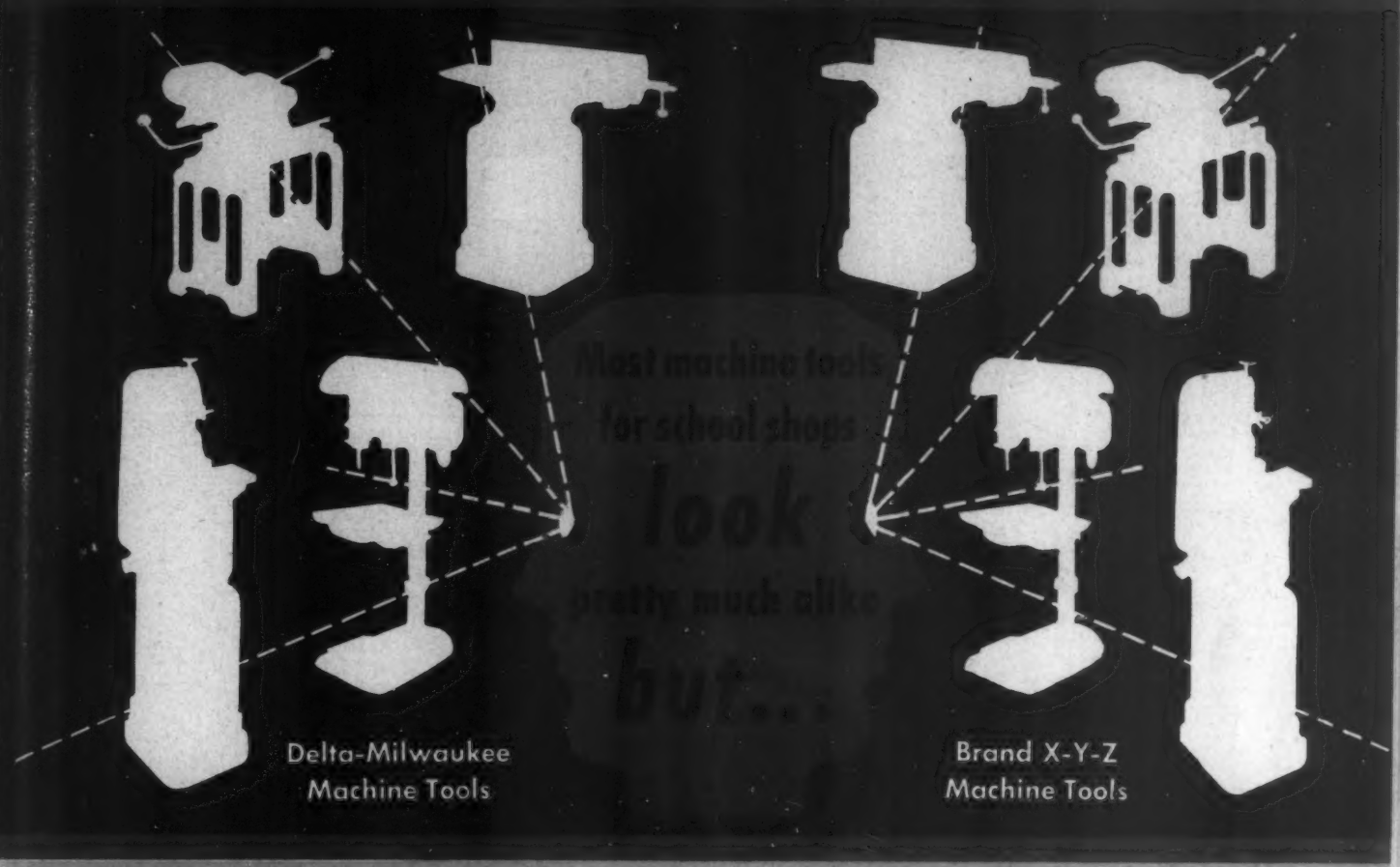
Plate or cut-film cameras lend themselves well to an extension of the distance between the lens and the sensitive film. With such an increase in the image distance considerable magnifications may be obtained directly without the necessity of enlargment of the exposed and developed negative. Such extensions may be made of light wood and may be attached to the camera with a simple light-tight lock. The plate or cut film holding back of the average camera is usually easily removable and may be fastened to the back of the extension to receive the film or plate holder. The exact method for making such attachments will be quickly apparent to the vocational teacher. In Figure 1 is shown a 30-in. extension. It is attached to a Speed Graphic camera with a Graflex back. This extension was attached to an old 4 x 5 in. plate holder by removing the center separator and fastening it with glue and small screws to the plywood extension box. At the other end a small frame was fastened duplicating the structure of the Graflex back. This was easily done by the use of sixteenth-inch by half-inch metal. This back permitted the fastening of the regular Graflex cut film or plate holder at a distance of 30 inches from the lens. With the 5¼ in. focal length lens in use, pictures magnified 6 times could be directly photographed at a distance to the object which permitted of easy handling and lighting. With this device rapid attachment to the camera is possible.

Some of the well-known miniature cameras may be equipped to fit the lens flange with a threaded extension tube. These may be screwed into the position of the lens and the lens screwed to the end of this tube. By use of tubes of various lengths and distance tables supplied by the manufacturer, magnifications of 12 diameters are not difficult to make. When film of fine grain and high resolving power is used such enlarged pictures may be printed by projection, in this way securing very useful illustrations. Excellent 2 by 2 in. projection slides may also be made from these pictures either by contact or projection printing.

Supplementary lenses which are either threaded or flanged for attachment to the regular lens barrel have the effect of changing the focal length of the camera lens so that enlarged pictures may be taken without benefit of camera extensions. These lenses are variously known by several names such as supplementary, portrait, and Porta lenses. They are of particular value when used with roll film cameras and those which have a single bellows-draw.

(Continued on page 37A)

Fig. 1. Thirty-inch extension to graphic camera with focusing screen in position



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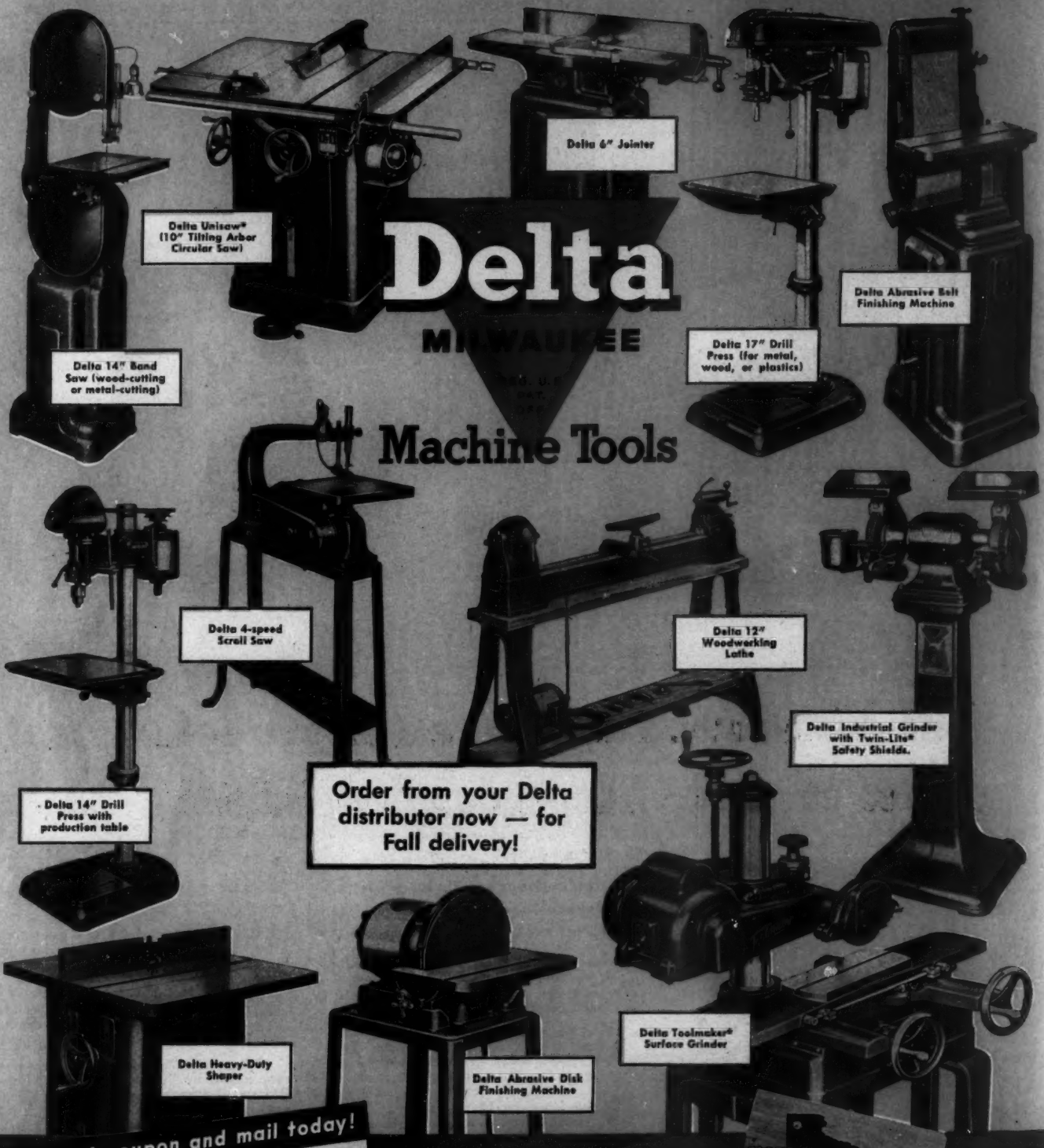
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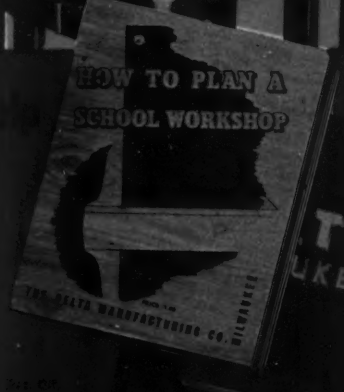

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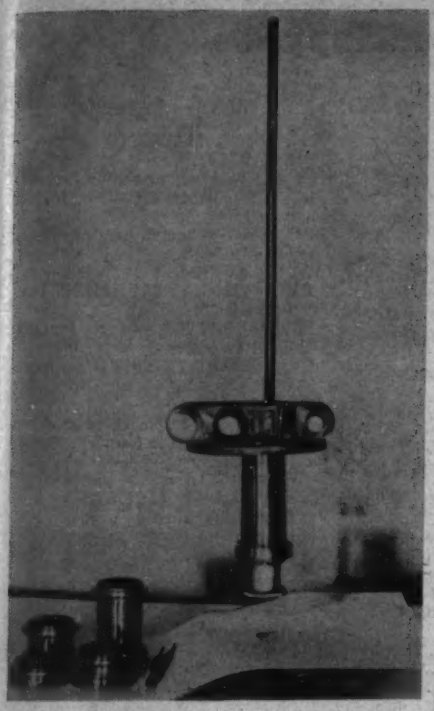

Fig. 2. Miniature camera with extension tube. Chemical ring stand in use as an adjustable support. Extension tubes of different sizes at left

Tables provided by their manufacturers permit of accurate focusing by use of a rule.

While cameras and objects to be photographed may be placed in any convenient position with relation to one another, the

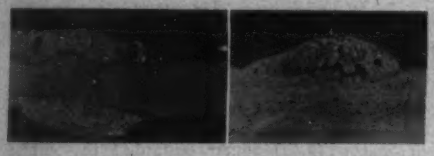

Fig. 3. Macrophotographs of sectioned and etched arc welds showing results of defective technique

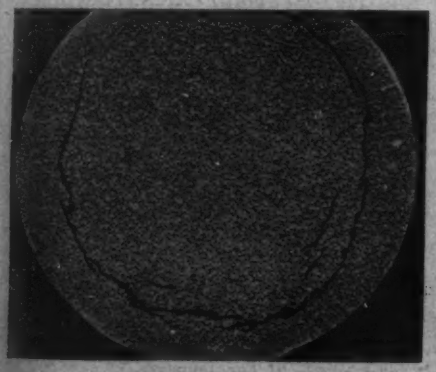

Fig. 4. Macrophotograph of sectioned and etched steel subjected to faulty heat treatment

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Over 100 types of Drop Forged Carbon and Chrome-Vanadium Wrenches. Each in all sizes.
ARMSTRONG
Drop Forged Lathe and Milling Machine Dogs
11 types, in all sizes with alloy screws hardened at point.
ARMSTRONG
High Speed Bits and Blades
Finest Cutting Steel, heat treated and hardened Also, ready-ground in standard cutter forms both "High Speed" and "Carbide-Tipped."
"ARMSTRONG BROS."
Better Pipe Tools
The most complete line manufactured. Each an improved tool built to Industrial Standards.
ARMSTRONG
Chrome-Vanadium Socket Wrenches
All sizes and types with drop forged ratchets.
Teach with the tools actually used by industry.

ARMSTRONG BROS. TOOL CO.

"The Tool Holder People"

322 N. Francisco Ave., Chicago 12, U. S. A.
Eastern Warehouse and Sales Office: 199 Lafayette St., N. Y.

vertical position is usually the most easily managed when macrophotographs are to be taken. For this purpose a stand of some kind is very useful for holding and adjusting the camera. It also permits of photographing the object in a stable position. Such stands are described in many texts and books, and are not difficult to build. In place of such a stand a chemical ring stand may be used to hold the camera and to adjust it readily. See Figure 2.

Shadow-free illumination is necessary for good results in most pictures. Ordinary incandescent or flood lights in adjustable reflectors provide the most dependable and constant source of light for macrophotographs. Fairly strong daylight may also be used effectively but it is not as convenient as artificial light.

Time of exposure can be fairly accurately gauged where artificial lights of known capacities are used for illumination. Time of exposure as recorded by exposure meters must be corrected to compensate for the longer lens-to-image distance in macrophotography. Exposure charts are available which give the required degree of compensation for every distance. These may be found in some of the photographic texts as well as in cards sold by some of the large photographic manufacturers.

A considerable variety of film suited to every photographic purpose is obtainable in the cut-film sizes. This is true to a somewhat less degree with miniature film. Ordinary roll film is made only in a few types. Fine-grain film with high resolving power

(Continued on page 44A)

Metalworking Equipment, Tools, and Supplies

These maximum lists may be found helpful in checking inventories or preparing budgets.

If possible, each shop should have access to a projector, so that stills, silent movies, or sound movies, may be used also in the student's industrial arts and vocational education courses.

AIR COMPRESSORS — for machine shop, foundry, or forge shop
ANVIL — 100 lb.
ARBOR PRESS — bench or pedestal type
BARROWS
- a) Coke
- b) Foundry
- c) Scrap

BELT LACER
BENCHES
- a) Coremaking
- b) For metal working, iron or steel legs. Tops, metal or hardwood lumber, 1¾ in. to 2½ in. thick
- c) Molding

BLACKBOARD — permanent or portable
BLOWERS — for furnaces, forges, etc.
BLOWTORCH — 1-qt. size
BOOKCASE — for reference books, catalogs, etc.
BORING BAR
BORING MILL — vertical or horizontal
BULLETIN BOARD
CABINETS — Wood or metal, for filing class records, instruction sheets, drawings, etc., and for tools and supplies
CASEHARDENING BOXES
CENTERING MACHINE
CHAIN HOISTS — differential, duplex or triplex
CHAIRS — teacher's, and tablet arm if needed for related-subjects room, or for demonstration section
CHUCK
- a) Drill, selected sizes
- b) Lathe, combination, 4 jaw, selected sizes
- c) Lathe, independent, 4 jaw, selected sizes
- d) Lathe, universal 3 jaw, selected sizes
- e) Milling machine, universal

CORE OVEN — for foundry
CRANES AND HOISTS — air, electric, or hand, of the jib, traveling, or portable type
CUPOLA — for foundry, coke, or electric, ¼- to 1-ton capacity
DESK — teacher's, with drawer compartments
DIE-FILING MACHINE
DIVIDING HEAD
DRILLS
- a) Bench, hand
- b) Breast
- c) Electric, portable
- d) Hand
- e) Post, hand or power
- f) Radial
- g) Sensitive
- h) Upright, power

FLASKS — 2 or 3 part, steel or snap type
FORGE — coal or gas, with hand- or electric-driven blower
FURNACES
- a) Annealing
- b) Bench
- c) Brass and soft metal
- d) Combination bench
- e) Casehardening
- f) Cyanide
- g) Gasoline
- h) Heat-treating
- i) Melting

GEAR-CUTTING MACHINE
GRINDER
- a) Bench, hand or power driven
- b) Combination grinder, buffer, and polisher
- c) Emery, bench or pedestal type
- d) Face, with magnetic chuck
- e) Portable tool post
- f) Precision, for external and internal grinding
- g) Universal tool cutter, drill and reamer grinder
- h) Wet tool

HACK SAW — motor or belt driven
HAND PICKS — for cleaning inside of cupola, 1¼ to 2½ lb.
HARDNESS TESTING MACHINE
LATHES — belt or individual drives
- a) Automatic
- b) Bench, 6-in. to 11-in. swing, 11 in. to 36 in. between centers
- c) Change gear, 9-in. to 14-in. swing, 18 in. to 36 in. between centers
- d) Quick-change gear, 9-in. to 16-in. swing, 18 in. to 36 in. between centers
- e) Semiquick-change gear, 9-in. to 18-in. swing, 18 in. to 42 in. between centers
- f) Turret
- g) Metal spinning

MILLING MACHINE
- a) Plain, cone or motor-driven type
- b) Universal, cone or motor-driven type

NIBBLING MACHINE
PIPE CUTTER
PLANER — belt or motor driven
POWER HAMMER — for forging operations
PUNCHES — metal, hand, or power
PYROMETER
PYROSCOPE
RELIEVING ATTACHMENT FOR LATHE
SAND SIFTER — for foundry, hand or power
SANDBLAST OUTFIT — with cabinet
SCALE
- a) Counter for machine shop
- b) Platform, for foundry, 1000-lb. capacity

SHAPER
SNAP-FLASK JACKETS — to fit snap flasks used
STRAIGHTENING PRESS
SURFACE PLATES
SWAGE BLOCK AND STAND — for forge shop
TAPER ATTACHMENT FOR LATHE
TRUCK — warehouse
TUMBLING BARREL — for foundry
VISES
- a) Blacksmith
- b) Drill press
- c) Machinist
- d) Pipe
- e) Planer
- f) Shaper

WELDING OUTFIT
- a) Acetylene
- b) Electric

Metalworking—Small Tools

ARBORS
- a) Drill chuck to suit requirements
- b) Reamers, various sizes
- c) Shell tool, various sizes
- d) Straight shank for shell reamers and shell drills, selected sizes
- e) Taper shank for shell reamers and shell drills, selected sizes

BEARING SCRAPER
BELLOWS — for foundry class
BEVEL PROTRACTOR
BROOMS AND FLOOR BRUSHES — for shop and foundry
BRUSHES
- a) Bench
- b) Core box
- c) Core painting
- d) Hard brushes for foundry
- e) Floor
- f) Soft brushes for foundry

BULB SPONGES — for molders
DRAW PINS — for molders
CALIPERS
- a) Hermaphrodite, 4 in. and 6 in.
- b) Inside, 4 in. and 6 in.
- c) Outside, 4 in. and 6 in.

CANS
- a) Oil, 1/3 pt., 1 pt., and 10 gal.
- b) Waste

CENTER TESTERS
CHISELS
- a) Cape, ⅛ in. and ⅝ in.
- b) Cold, ⅜ in. and ¾ in.
- c) Diamond point, ⅜ in. and ½ in.
- d) Roundnose, ⅜ in. and ½ in.

CLAMPS
- a) 4 in., 6 in., 8 in., and 10 in.
- b) Flask, for foundry
- c) Strap, various sizes

CAKE FORKS — for foundry
COLLETS
- a) For milling machine, selected sizes
- b) For lathe, selected sizes

COMBINATION SQUARES—with hardened head and blade, and protractor head, 9 in. and 12 in.
COUNTERBORES — straight and tapered shanks, selected sizes
COUNTERSINKS — for metal
CRUCIBLE TONGS — to fit crucibles
CRUCIBLES — selected sizes
- a) Shanks, single end to fit ladles
- b) Shanks, hand, to fit ladle bowls

CUTTERS — angular milling, bevel gear, concave milling, convex milling, end milling, face milling, formed milling, grooving, involute gear teeth, key seat, side milling, and metal slitting

DIVIDERS — Spring, 4 in. and 6 in.
DRILLS
- a) Drifts, different sizes
- b) Sleeves, different sizes
- c) Stand for Nos. 1 to 60
- d) Stand for 1/16 in. to ½ in. by 64ths

DRILLS
- a) Center
- b) High speed, taper shank, various sizes
- c) Jobbers, straight shank, 1/16 in. to ½ in. by 64ths
- d) Ratchet
- e) Straight shank, Nos. 1 to 60
- f) Taper shank, ½ in. to 1 in. by 16ths

FILE CARDS
FILES
- a) Die sinkers, various shapes
- b) Flat bastard, 8 in., 10 in., 12 in., and 14 in.
- c) Half round, double cut, 6 in., 8 in., 10 in., and 12 in.
- d) Hand, smooth, 8 in., 10 in., and 12 in.
- e) Mill, smooth, 8 in., 10 in., and 12 in.
- f) Round bastard, 8 in., and 10 in.
- g) Square bastard, 8 in., and 10 in.
- h) Swiss, various shapes
- i) Three-square, double cut, 6 in.
- k) Warding, double cut, 6 in.

FIRST-AID CABINET AND SUPPLIES
FORGE TOOLS — drift pins, flatters, fullers, hand and handle punches, hardies, hot and cold cutters, set hammers, and swages for the forge shop
GATE STICKS — maple, for foundry
GAUGES
- a) Center
- b) Depth
- c) Drill and wire
- d) Screw pitch, select kinds
- e) Surface
- f) Thickness

GLOVES — asbestos, for foundry
GOGGLES
- a) For machine shop
- b) For foundry

HACK SAW
- a) Blades, hand, 18T, 10 in.

(Continued on page 40A)

TRAIN THEM ON MACHINES

that are used in production

CINCINNATI 12" Hydraulic Universal Grinder handles an unusually wide range of grinding operations. Catalog G-486-3 contains complete specifications.

CINCINNATI No. 2MI Plain Miller. The versatility and safety features of this machine make it ideal for school shop use. Catalog M-1429 contains complete specifications.

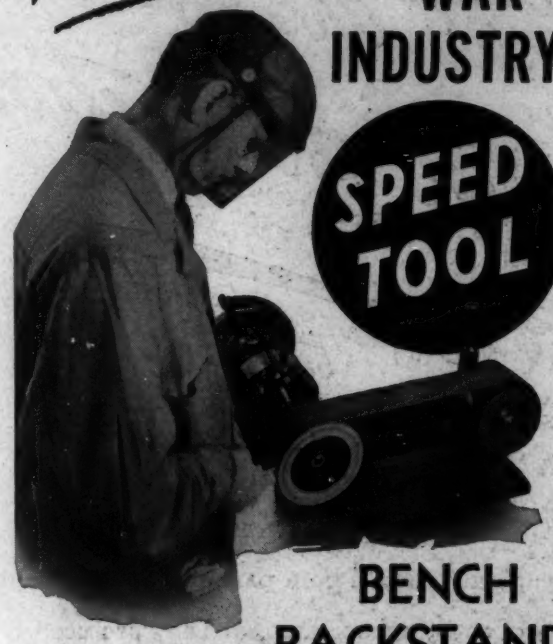
● There are several reasons why these CINCINNATI Milling and Grinding Machines should be a part of the equipment of every school shop. a) They are used in all types of manufacturing shops; b) they handle a wide variety of operations; c) all controls are quick, positive and within easy reach; d) they are unusually safe to operate; e) all rotating parts are covered—a further safety factor; f) the No. 2MI Miller has an automatic kickout of hand levers when power feed or rapid traverse is engaged; g) both have automatic lubrication which saves the machines in case students forget to oil them. ¶ We suggest you investigate these machines for your student training program.

THE CINCINNATI MILLING MACHINE CO.
CINCINNATI GRINDERS INCORPORATED

CINCINNATI 9, OHIO, U. S. A.

And NOW

WAR INDUSTRY'S



BENCH BACKSTANDS

for SHOP INSTRUCTION

Abrasive belt grinding with idler backstand converted polishing lathes is easily the greatest coated abrasive development to come out of the war production program.

Demonstrating the same belt-conversion principle as the larger floor models, bench backstands are a shop must—an all purpose tool that grinds, sands, finishes, polishes—and sharpens.

For shop instruction on production grinding and finishing of castings, forgings and stampings, backstands are now available either as complete bench units or as bench type idler backstands for converting standard bench grinders (½ H. P. or larger). Send in the coupon for informative booklet giving complete information.

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Quality Coated Abrasives Since 1872

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Please send Backstand booklet, "Plus Factors."
Name..... Title.....
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City..... Zone..... State.....

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(Continued from page 38A)

- *b*) Blades, power, 14T, 12 in.
- *c*) Frames, adjustable

HAMMERS
- *a*) Babbitt
- *b*) Ball peen, 13 oz., 16 oz., or 20 oz.
- *c*) Blacksmith's, various kinds
- *d*) Riveting, 9 oz., and 12 oz.
- *e*) Setting

INDICATOR
- *a*) Center
- *b*) Universal or universal dial test
- *c*) Speed

KNURLING TOOL — with assorted knurls

LADLES
- *a*) Bull
- *b*) Hand bowls
- *c*) Melting

LATHE DOGS — ½ in., ¾ in., 1 in., 1½ in., 2 in., 2½ in., and 3 in.

LEGGINGS — fireproofed duck, to protect students when pouring in foundry

LEVEL — 6-in. bench

LIFTING SCREWS — for molders

MALLETS — wood or soft

MANDRELS — selected sizes

MICROMETERS — inside, 1½ in. to 8 in.; outside, 0 to 1 in.; outside, 1 in. to 2 in.; outside, 2 in. to 3 in.

MOLDING BOARDS

MOLDING STICKS AND TROWELS — various kinds

NIPPERS — end cutting, 5 in.

OIL STORAGE TANK — with pump

OILSTONES — medium and fine

PAILS — galvanized, 12-qt. capacity for foundry

PARALLELS
- *a*) Adjustable
- *b*) Steel, assorted sizes

PLIERS
- *a*) Combination, 6 in.
- *b*) Side-cutting, 6 in.

PUNCHES
- *a*) Center, ¼ in. and ⅜ in.
- *b*) Hollow, ½ in., ¾ in., and 1 in.
- *c*) Pin, ⅜ in., 5/32 in., 3/16 in., 7/32 in., and ¼ in.
- *d*) Prick, ¼ in.

RAMMERS — for foundry
- *a*) Hand
- *b*) Floor

REAMERS — various sizes
- *a*) Adjustable
- *b*) Hand
- *c*) Taper pin
- *d*) With taper shank

RIDDLES — ¼-in. and ⅛-in. mesh, 18-in. diameter, for foundry

RIVET SETS — assorted sizes

SCALES
- *a*) Steel, 6 in., graduated 1/64 in. to ½ in.
- *b*) Steel, 12 in., graduated to 32nds

SCREW DRIVERS — 6 in. and 9 in. blade

SCRIBERS

SHOVELS
- *a*) Coke
- *b*) Sand

SNIPS — tin, 3 in. straight and 3 in. curved

SOCKETS — for taper shanks, drill and tools, selected sizes

SOLDERING COPPERS AND HANDLES — 1-lb. size

SPRAY CAN — for molders

SPRINKLING CANS — galvanized iron, 16-qt. capacity, for foundry

SPRUE PICKS — for molders

SQUARES
- *a*) Machinist's, 6 in.
- *b*) Blacksmith's

STEEL FIGURES, ⅛ in.

STEEL LETTERS — ⅛ in.

SWABS — for molders

TAPELINE — steel, 25 ft.

TAPS AND DIES
- *a*) Machine screws
- *b*) Pipe
- *c*) N.F. ¼ in. to ¾ in.
- *d*) N.C. ¼ in. to ¾ in.

TONGS
- *a*) Blacksmith's, various kinds
- *b*) Pick up, for foundry
- *c*) Shake out, for foundry

TOOL HOLDERS
- *a*) Boring tools
- *b*) Cutting-off tools
- *c*) Planer
- *d*) R.H. and L.H. offset shank
- *e*) Shaper
- *f*) Slotter
- *g*) Straight shank
- *h*) Threading

TOOL-HOLDER BITS — square, ¼ in., 5/16 in., ⅜ in., 7/16 in., ½ in.

TRAMMEL POINTS

V BLOCKS AND CLAMPS

WHEEL DRESSER

WRENCHES
- *a*) Adjustable, 8 in. and 10 in.
- *b*) Pipe, 8 in. and 12 in.
- *c*) Tap, adjustable, various sizes

Metalworking— Materials and Supplies

ABRASIVE CLOTH — aluminum oxide. Grits 320 to 24, obtainable in sheets or rolls from 1 to 28 in. wide

ABRASIVE WHEELS

ACETYLENE GAS — in drums for welding

ALUMINUM
- *a*) Pigs for foundry
- *b*) Sheets, tubing, rounds, shapes, wire, etc.

BABBITT METAL

BEARING BLUE

BELT DRESSING

BELT LACING MATERIAL

BELT LEATHER

BOLTS
- *a*) Carriage, selected sizes
- *b*) Lag, selected sizes
- *c*) Machine, selected sizes
- *d*) N.F., selected sizes
- *e*) Stove, flat or roundheads, selected sizes

BRASS
- *a*) Bars, 3/32 in., ⅛ in., 4/16 in., and ¼ in. thick; ⅜ in. to 1 in. wide, 8 ft. to 10 ft. long, selected sizes
- *b*) Round rods, 3/16 in. to ½ in. by 16ths, selected sizes
- *c*) Sheets, 28 to 32 American gauge, 12 in. wide by 72 in. to 84 in. long, selected sizes

(Continued on page 42A)

MORE TOOLS for MORE STUDENTS WHEN YOU REQUISITION Atlas

Thoughts running through many an industrial arts teacher's mind these days:

"Shop crowded with more students than ever — demand next fall will be even greater — budget is small — space limited — how can I provide enough equipment?"

If these are your problems, Atlas machine tools will help you solve them. Their size allows you to make the most of your shop's floor space. Their cost enables you to stretch your allocation, have more tools per student.

Atlas lathes, drill presses, milling machines, and shapers are compactly built. You don't buy more machining capacity than you need — yet this versatile bench equipment is ideal for teaching and providing sound experience in every fundamental tool operation.

Atlas tools proved their long life and efficiency on the grueling production lines of the war years. Ruggedly built, they will stand up under the inexpert handling of beginning students. Precision-built, they have the fine tolerances required for accurate work. These are the same tools many students will later use on the job. If you're going to need more tools for more students next fall, requisition Atlas.

Send for Latest Catalog

This 64 page, completely illustrated catalog contains all the work range and tool specifications you'll need to consider Atlas tools in making up your new recommendations and requisitions. Send for your copy today.

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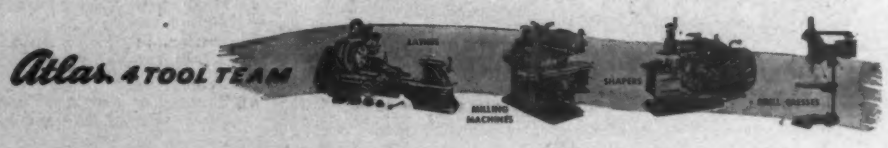
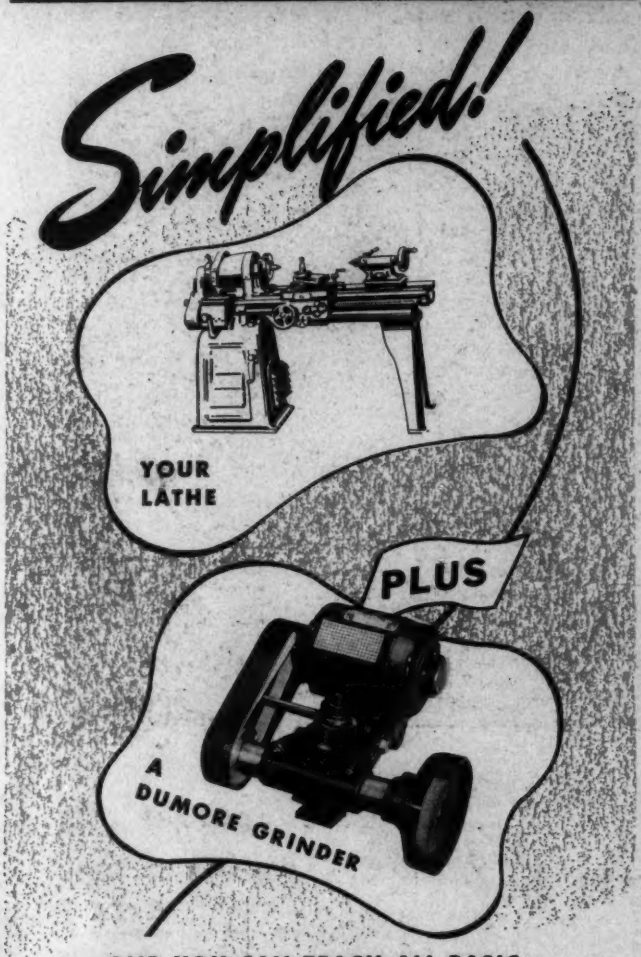


PRECISION GRINDING INSTRUCTION



. . . AND YOU CAN TEACH ALL BASIC TYPES OF PRECISION GRINDING

● You can teach practically everything there is to know about grinding—internal, external, surface, thread grinding and other special types—simply by adding a Dumore Precision Grinder to a lathe or other shop machine. Its low cost easily brings it within the school budget.

Accurate to .0001", precision-built for long, hard service, a Dumore Grinder is ideally suited to your needs. Write for Dumore Catalog No. 42. The Dumore Company, Tool Division, Dept. TC22, Racine, Wis

DUMORE

PRECISION AND HAND GRINDERS

SOLD BY AUTHORIZED INDUSTRIAL DISTRIBUTORS IN ALL PRINCIPAL CITIES

(Continued from page 40A)

d) Strips, 1/32 in. and 1/16 in. thick, ½ in. to 1½ in. wide, 50 ft. to a coil, selected sizes
e) Threaded rods, Nos. 6 to 10, in 24 in. lengths. Nos. 12, 14, ¼ in., and 5/16 in., in 24 in. lengths, selected sizes
f) Wire, soft, 8, 11, and 14 American gauge, selected sizes
g) Wire, spring, 8 to 22 American gauge, selected sizes

CASEHARDENING COMPOUNDS

CHAPLETS — single and double head

COAL
a) Charcoal for foundry or forge
b) Coke for foundry
c) Forge

COPPER
a) Pigs, for casting alloys
b) Sheets, 8 to 25 American gauge, 30 in. by 60 in., selected sizes
c) Tubing, outside diameters, 3/16 in., ¼ in., 5/16 in., ⅜ in., ½ in.; thickness of wall, 1/32 in.; lengths, 8 ft. to 12 ft., selected sizes
d) Wire, soft, 2 to 20 American gauge, in coils. Also in ¼, ½, and 1 lb. spools, sizes 16 to 36, English gauge, selected sizes

CORE
a) Compounds
b) Flour
c) Paste
d) Oil
e) Wax-vent wire

CUTTING COMPOUNDS

FIREBRICKS AND CLAY — for foundry

FIRE HANDLES — assorted sizes

GRAPHITE — for foundry

IRON — Pig, for foundry

LACQUER — transparent and colored, for finishing

NUTS — S.A.A., acorn cap, castellated, square, hexagon, joint, and wing, selected sizes and kinds

OIL
a) Boiled linseed
b) Lubricating
c) Quenching and hardening

PACKING
Round, sheet, square, or tubular

PAINT — back asphaltum

PINS
a) Cotter, 3/32-in. to ¼-in. diam. from ½ in. to 2 in. long
b) Flask, for flask repairs
c) Taper, Nos. 0 to 6, ¾ in. to 2 in. long

PUMICE POWDER

RIVETS
a) Copper, with burrs, Nos. 7 to 14, lengths, ⅛ in. to ¾ in., selected sizes
b) Iron, No. 14 gauge to 3/16 in., flathead or button head, ¼ in. to 1 in. long, selected sizes
c) Tinners', flathead, 8 oz. to 16 lb., either tinned or black, selected sizes

SAND
a) Molding, in 350-lb. barrels or 800-lb. casks
b) Parting, in 350-lb. barrels or 800-lb. casks

SCREWS
a) Flathead or roundhead iron or brass, selected sizes and kinds
b) Cap and machine, iron or brass, selected sizes and kinds
c) Set, head and headless

SOLDER — acid or rosin core; bar, or solid wire

SOLDERING PASTE OR SALTS

STEEL
a) Bessemer, rod, 1/64 in. to ⅜ in. by 64ths, in 4-ft. lengths, selected sizes
b) Bars, cold rolled, ⅛ in. to ⅜ in. thick, ½ in. to 2 in. wide, 12-ft. lengths, selected sizes
c) Drill rod, letter sizes, A to Z, number sizes, 1 to 80, in 3-ft. lengths, selected sizes
d) Rods, hexagon and square, cold rolled, ¼ in. to ¾ in., in 12-ft. lengths, selected sizes
e) Round, cold rolled, diameters ⅛ in. to 1 in., lengths 12 ft., selected sizes
f) Sheet, black, Nos. 18, 20, 22, 24, 26, 28, U. S. gauge; size of sheets, 24 in., 28 in., and 30 by 96 in.
g) Sheet, galvanized, Nos. 18, 20, 22, 24, 26, 27, and 28 U. S. gauge; size of sheets, 24 in., 28 in., and 30 by 96 in., selected sizes
h) Threaded rods, Nos. 6 to 10, in 12-in. lengths. Nos. 12, 14, ¼ in., and 5/16 in., in 24-in. lengths, selected sizes

TIN
a) Pigs, for casting alloys
b) 1C, 1X, 20 by 48 in.
c) 1XX, 20 by 48 in.

WASHERS AND BURRS
a) Copper, burrs, Nos. 3 to 14, in 1-lb. boxes
b) Iron burrs, Nos. 3 to 14, in 1-lb. boxes
c) Brass washers, 3/16 in. to ½ in. by 16ths
d) Iron washers, 3/16 in. to ½ in. by 16ths

WELDING FLUXES

WELDING RODS (all rods come in 24-in. lengths)
a) Brazing, 1/16-in., ⅛-in., and 3/16-in. diameter
b) Cast aluminum, 3/16-in., ¼-in., and ⅜-in. diameter
c) Cast brass, 3/16-in., and ⅛-in. diameter
d) Cast bronze, ¼-in. diameter
e) Cast copper, 3/16-in. and ¼-in. diameter
f) Cast iron, 3/16-in., ¼-in., 5/16-in., and ⅜-in. diameter
g) Low carbon steel, ⅛-in., ¼-in., and ¼-in. diameter

WHITE LEAD — for machine shop

WIRE
a) Annealed, 16 to 34 W and M gauge, selected sizes
b) Coppered market, 5 to 18 W and M gauge, selected sizes
c) Coppered spring, 2 to 18 W and M gauge, selected sizes
d) Galvanized, 5 to 18 W and M gauge, selected sizes
e) Piano, Nos. 2/0 to 36, selected sizes
f) Tinned, 16 to 24 W and M gauge, selected sizes
g) Wool, Nos. 0 to 3 in 1-lb. packages, selected sizes

ZINC
a) Pigs, for casting alloys
b) Sheet, Nos. 4 to 14, sheets 36 in. by 84 in.

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16-MM SOUND

461 FT. ONLY $19.00

THE WOOD LATHE

(Turning Taper Work)

The film "Turning Taper Work" shows and explains skills and procedures that are basic in the instruction of all classes in woodworking. It graphically illustrates the various steps in one of the most important wood lathe operations . . . centering cylindrical stock for spindle turning . . . rough-turning the stock . . . clearance cuts . . . establishing diameters of a taper . . . turning a single taper . . . turning two tapers on one piece of stock, etc. It offers every instructor the finest kind of help with the best of the modern tools of instruction. With the film you get a helpful and important Instructors' Manual. At slight extra cost you can obtain an important Filmstrip containing 49 frames for reviewing and clarifying parts of the motion picture.

Teacher! If your school is equipped with a 16-mm sound projector, obtain your copy of this complete visual aids catalog. ***IT'S FREE!***

Gain the help in your peacetime instruction of these war-proven visual aids. They are especially effective for basic instruction in peacetime. Here is the most complete and authoritative library of visual aids in science and vocational education yet produced. Many instructors are using them in science, physics, mathematics, vocational guidance and vocation instruction. They were made by the U. S. Office of Education with the fullest cooperation of the foremost authorities in the country. You too can make your teaching of difficult concepts and principles easier and more effective through using these 16-mm sound motion pictures. Here are a few examples of the many subjects available:

- Your Driving Habits
- Care of the Newborn Baby
- The Supervisor as a Leader
- The Slide Rule
- Using a Portable Spray Gun
- Sawing with a Jig Saw
- The Electron
- Principles of Refrigeration
- The Airplane Mechanic
- Origin and Synthesis of Plastics
- Wiring Old Buildings with Armored Cable
- Rotary Magnetic Fields

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☐ Remittance enclosed ☐ Send C.O.D. ☐ SEND U.S.O.E. CATALOG

Quick Acting
Johnson
FURNACES

Teach Heat-Treating with JOHNSON Hi-Speed Furnaces

Harden ANY Steels, Dies, Tools or Small Metal Parts at Low Cost

Heat Up FAST to Allow MORE Actual Classroom Time

•

JOHNSON No. 120

Reaches 1500° F. in 5 Min. 2300° F. in 30 Minutes

•

Here is the ideal unit for teaching heat-treating. Johnson Hi-Speed No. 120 is widely used in large and small shops for hardening punches, dies and tools. Excellent for heat-treating high-speed steels. Compact, powerful and remarkably economical in operation. Temperatures easily regulated. Firebox 5 x 7¾ x 13½ lined with high temperature insulating refractory. Equipped complete with Carborfrax Hearth, G.E. Motor and Johnson Blower.

$129.50

F.O.B. Factory

•

JOHNSON No. 70 Bench Furnace

2250° F. in 30 Minutes

•

$89.50

F.O.B. Factory

•

Designed primarily for high-speed steels, Johnson Hi-Speed No. 70 is equally efficient for hardening ANY steels, punches, dies, cutting tools or small metal parts. Firebox 5 x 7¾ x 9 lined with high temperature insulating refractory. Equipped complete with Carborfrax Hearth, G.E. Motor and Johnson Blower.

•

NOTICE

Send in your present Johnson furnaces for factory rebuilding write for particulars.

GET Quick Action with JOHNSON Units

Famous for economy and efficiency since 1901, Johnson Furnaces reach operating temperatures FAST . . . save time, saves space, save gas. Write for complete catalog describing furnaces for all pot-hardening, melting, annealing and heat-treating purposes.

JOHNSON GAS APPLIANCE CO.
585 E. Avenue N.W., Cedar Rapids, Ia.

Please send me a Free Johnson Catalog

Name .....

Address .....

City ..... State .....

(Continued from page 37A)

is best adapted to macrophotography since it provides fineness of grain and good resolving power to record accurately the details of the object photographed. Film so made should be developed in one of the fine-grain borax or phenylene diamine developers and printed on glossy photographic paper or on slides for projection. Where color is of importance, excellent transparencies may be made which may be used for projection. Infra red film, which records only the invisible rays immediately adjacent to the visual red of the spectrum can often show details which the eye cannot distinguish.

Contrast light filters, particularly the orange, red, green, blue, or violet types are often extremely useful in accentuating details which may not be evident to the eye, even with magnifying aids. Detailed instruction in the use of filters may be found in many of the photographic texts and in some of the literature issued by large photographic supply companies.

THE TEACHER PLANS HIS WORK

E. H. CURRY

Wayne University
Detroit, Mich.

The shop teacher must admit that for many years he did very little in the way of writing lesson plans, daily plans, weekly plans, or any other type of plans in order that he might perform a systematic job of teaching. With the arrival of the general shop and large classes, the modern teacher soon discovered that some type of planning was necessary. After many years of experimenting with various plans, the master demonstration plan that is described in this article was produced as an aid to better teaching. Please note that this is not a daily lesson plan, but a plan that covers several days of instruction. This same plan may be used from year to year if it is deemed desirable to repeat the project to another group.

This master demonstration plan is divided into the ten following parts:

A. Instructional units
   1. Operations
   2. Technical information
B. Tools and equipment necessary to do the job
C. Materials necessary to do the job
D. Items other than tools and materials needed by the teacher
E. Daily plan for teaching
F. Drawings and sketches
G. Steps in doing the job
H. References
I. Standard time
J. The unit test

The Instructional Units

The instructional units are placed first in the master demonstration plan because these are the items that a teacher must cover when demonstrating or discussing the project that he has selected. The in-

(Continued on page 48A)

	WOODWORKING OPERATIONS	Letter Opener	Tie Rack	Window Stick	Clothes Stick	Reminder Pad	Eraser Block	Book Ends	Toy Racer	Mail Box	Screen Frame
1.	Measure with a rule	1	1	1	1	1	1	1	1	1	1
2.	Get out stock	2		2	2	2	2	2	2	2	2
3.	Saw to a line with a ripsaw	3		3	3	3	3	3	3	3	3
4.	Saw to a line with a crosscut saw	4		4	4	4	4	4	4	4	4
5.	Sand wood surfaces	5	5	5	5	5	5	5	5	5	5
6.	Lay out a design	6	6	6	6	6	6	6	6	6	6
7.	Assemble and adjust plane			7	7	7	7	7	7	7	7
8.	Plane a surface true and smooth			8	8	8	8	8	8	8	8
9.	Plane an edge			9	9	9	9	9	9	9	9
10.	Plane an end			10		10		10	10	10	
11.	Trim with a chisel			11	11			11	11	11	
12.	Drill holes		12			12		12	12		12
13.	Saw a curve	13	13					13		13	
14.	Fasten with screws		14			14		14	14		
15.	Bore holes				15	15			15	15	
16.	Square stock					16	16	16		16	
17.	Glue up stock		17				17		17	17	
18.	Drive and draw nails							18	18	18	
19.	Form with a spokeshave							19	19	19	
20.	Do gouge work						20		20		
21.	Fasten with hand screws and "C" clamps									21	21
22.	Whittle with a knife	22									
23.	Plane a chamfer or bevel					23					
24.	Lay out and cut a dado joint							24			
25.	Lay out and cut a miter joint										25
26.	Lay out circles or radii							26	26		
	TECHNICAL INFORMATION										
A	Plan a procedure	A	A	A	A	A	A	A	A	A	A
B	Read a working drawing			B	B	B	B	B	B	B	B
C	Make a bill of material	C	C	C	C	C	C	C	C	C	C
D	Read a rule			D	D	D	D	D	D	D	D
E	Common woodworking rules and square			E	E	E	E	E	E	E	E
F	Kinds and uses of common woods	F	F	F	F	F	F	F	F	F	F
G	Kinds and sizes of handsaws	G	G	G	G	G	G	G	G	G	G
H	Kinds and uses of sandpaper	H	H	H	H	H	H	H	H	H	H
I	Sizes of auger bits and drills		I		I	I		I	I	I	
J	Sizes and kinds of wood screws		J			J		J	J	J	
K	Uses of brads and nails								K	K	K
L	Kinds and uses of glue		L				L				
M	Kinds and uses of planes			M	M	M	M	M	M	M	M

Fig. 1. This analysis was taken from the Analysis of Activities in Household Mechanics by the Board of Education of Detroit, Mich.

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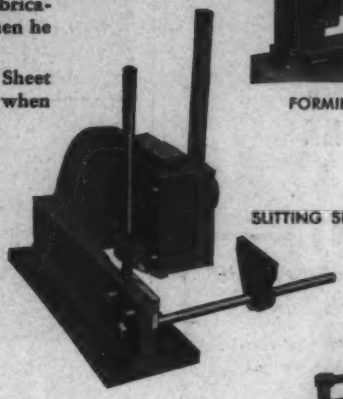
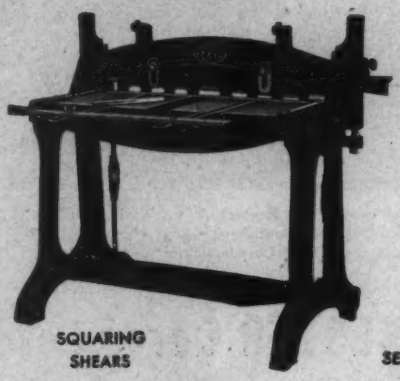


SLITTING SHEARS

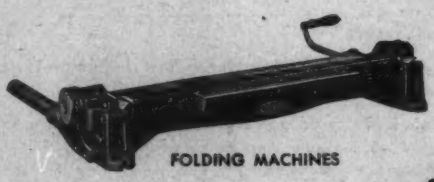


SQUARING SHEARS

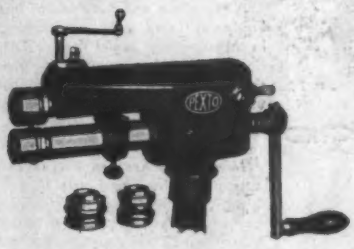
COMB. ELECTRIC ROTARY MACHINES

COMB. ROTARY MACHINES

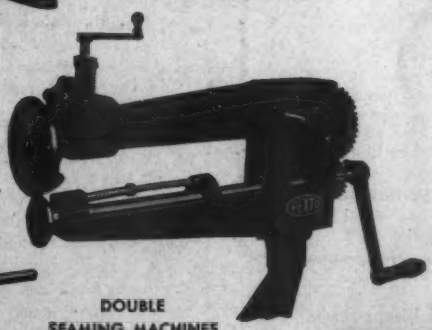
SETTING DOWN MACHINES



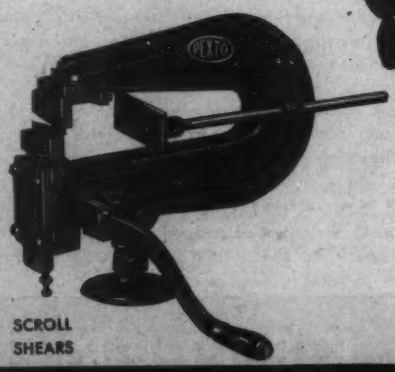
FOLDING MACHINES



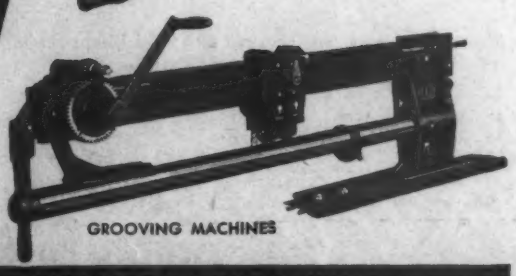
BEADING MACHINES



DOUBLE SEAMING MACHINES



SCROLL SHEARS



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Projects in Art Metal, Jewelry and Wrought Iron — Figure C1

12 folio pages, containing 21 designs with instructions. Some of the designs embody religious motifs. Each page contains a list of tools and materials necessary for the completion of the project. PRICE $0.80

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These maximum lists may be found helpful in checking inventories or preparing budgets.

If possible, each shop should have access to a projector, so that stills, silent movies, or sound movies, may be used also in the student's industrial arts and vocational education courses.

AIR COMPRESSOR
- *a*) 3 to 4 cu. ft., with tank, piping, and motor
- *b*) Small portable, 1 cu. ft., with motor

ALIGNING JIG — for connecting rods

ANVIL
- *a*) No. 100 or No. 125
- *b*) Rim

ARMATURE GROWLER AND TESTER

AXLE STANDS

BATTERY EQUIPMENT
- *a*) Cell tester, panel type with discharge rack
- *b*) Charger (15-battery size) with rack
- *c*) Charger (6-battery size)
- *d*) Gas stove (small)
- *e*) Lead-burning torches, with gauges and piping
- *f*) Plate racks

BENCH
- *a*) Electric test, elaborate
- *b*) Electric test, simple
- *c*) Work, with vises
- *d*) Work, portable with vise

BLACKBOARD

BLOWTORCHES — 1-qt. size

BOOKCASE

BRAKE
- *a*) Adjusting stand
- *b*) Band-lining machine

BULLETIN BOARD

CABINETS
- *a*) Wood or metal, for bolts and supplies
- *b*) Wood or metal, for filing job sheets and correspondence

CHAIN HOIST — with overhead trolley and track

CHAIRS
- *a*) Teacher's
- *b*) For tables, or with tablet arms

CRANE — portable

CRANKSHAFT TRUING TOOL

CREEPERS

DESK — teacher's

DRILL
- *a*) Breast
- *b*) Hand
- *c*) Electric portable, ⅛ in.
- *d*) Electric portable, ¼ in.
- *e*) Press, 21 in., with motor and chuck

DYNAMOMETER — electric

FORGE — with blower and tools

FURNACES — gas

GREASE DISPENSERS

GRINDER
- *a*) Cylinder with motor
- *b*) 8 in., with motor
- *c*) 12 in., with motor

HONES — cylinder

JACKS
- *a*) Lever, 1½-ton
- *b*) Floor, roller

LATHE
- *a*) 11 in. by 4 ft., with motor, chucks, and attachments
- *b*) 16 in. by 6 ft., with motor, chucks, and attachments

PRESS
- *a*) Arbor
- *b*) 30 ton

SPRAY PAINTING OUTFIT

VALVE REFACING MACHINE

VULCANIZER
- *a*) Electric steam for tube work
- *b*) Small, hand

WELDING OUTFIT — with tanks, gauges, and cutting torch

WHEEL ALIGNMENT
- *a*) Gauge
- *b*) Test table

Automotive Shop—Small Tools

ABRASIVE — rubstone for cleaning castings in foundry

ALCOHOL TESTER

BATTERY
- *a*) Cell tester, prod type
- *b*) Cell tester, cadmium
- *c*) Clips, large
- *d*) Element pullers
- *e*) Fillers
- *f*) Funnels, glass
- *g*) Hydrometer, acid
- *h*) Knives
- *i*) Post builders
- *k*) Post drills
- *l*) Post markers
- *m*) Separator trimmer

BITS
- *a*) Expansive
- *b*) Ratchet brace
- *c*) Wood, 3/16 in. to 1 in.

BOLT CUTTER — 24 in. and 36 in.

CALIPERS — 6 in. inside and outside

CANS
- *a*) Oil, 1/3 pt.
- *b*) 1 gal., gas, safety
- *c*) 5 gal., gas, safety
- *d*) 5 gal., kerosine
- *e*) Waste

CHECKS — tool, 1000, blank

CHISELS
- *a*) Cape, 3/8 in. and 5/8 in.
- *b*) Cold, 3/8 in., 5/8 in., ¾ in., 1 in.
- *c*) Diamond point

COMBINATION SQUARES — 12 in.

COTTER-PIN EXTRACTOR

DIVIDERS — 6 in. and 10 in.

DRILL SETS
- *a*) 1/32 in. to 1/2 in., by 64ths
- *b*) 1/2 in. to 1¼ in., by 32nds

FILE CARDS

FILE HANDLES — assorted

FILES
- *a*) Flat bastard, 6 in., 8 in., 10 in., and 12 in.
- *b*) Half round, 6 in., 8 in., 10 in., and 12 in.
- *c*) Mill, 6 in., 8 in., 10 in., and 12 in.
- *d*) Round, 6 in., 8 in., 10 in., and 12 in.
- *e*) Square, 8 in., 10 in., and 12 in.

FIRE EXTINGUISHERS — Pyrene and Acid

FIRST-AID CABINET AND SUPPLIES

FLOOR BRUSHES — 18 in.

FUNNELS — tin, assorted sizes

GAUGES
- *a*) Air pressure
- *b*) Center
- *c*) Depth
- *d*) Thread
- *e*) Thickness

GLASS CUTTERS

GOGGLES

GREASE GUNS — plain and pressure type

HAMMERS
- *a*) Ball peen, 4 oz.
- *b*) Ball peen, 1¼ lb.
- *c*) Ball peen, 2 lb.
- *d*) Lead
- *e*) Riveting
- *f*) Sledge, No. 12

LADLE
- *a*) 3-in. bowl
- *b*) 6-in. bowl

LAMPS — extension, with reels

LEAD POT — gas

MAGNET CHARGER

METERS — volt and ammeter test

MICROMETERS
- *a*) Outside, 0 to 1 in.
- *b*) Outside, 2 in. to 3 in.
- *c*) Outside, 3 in. to 4 in.
- *d*) Inside, 1½ in. to 6 in.

MOLDS
- *a*) Battery nut
- *b*) Battery post
- *c*) Battery strap
- *d*) Burning stick
- *e*) Lead hammer

OILSTONE

PIPE TAPS — ⅛ in., ¼ in., ⅜ in., and ½ in.

PLIERS
- *a*) Combination, 6 in.
- *b*) Flat nose
- *c*) Roundnose

PULLERS
- *a*) Bearing
- *b*) Gear
- *c*) Wheel, hub type

PUNCHES
- *a*) Center
- *b*) Taper pin
- *c*) Blacksmith

PUTTY KNIVES

(Continued on page 50A)

(Continued from page 44A)

structional units are selected from the analysis of the subject matter which is to be covered in the course of study. See Figure 1. In listing the operations and technical information on the plan (see Fig. 2, page 58A) you will note from the sample master demonstration plan that the numbers and letters preceding them are the same as in the analysis. This is done for reference purposes. In some cases it may be well to star the operations and technical information that the teacher wants to stress most in presenting the lesson.

Tools and Equipment Necessary to Do the Job

A tool and equipment list is a necessary part of the master demonstration plan. This list is needful for the following reasons: First, from this prepared list the teacher can check the names of tools that the students write into their plans of work; second, it gives the instructor an opportunity to survey his inventory of tools in order that all pieces of equipment are available to build the project; third, it gives the teacher a list to follow when gathering the necessary tools for each demonstration.

Materials Necessary to Do the Job

A material list is indispensable for the same reason that it is necessary to have a tool and equipment list. It is, therefore, included in the master demonstration plan. Also, it is a perfect check on the nomenclature of various materials you are going to use when presenting the related information concerning these materials.

Items Other Than Tools and Materials Needed for the Demonstration

The tool and material list covers only equipment and materials that a teacher or student would need in building a project. An instructor, in order to give a well-rounded demonstration, needs other items. Some of these items that might be used are displays of different kinds of screws, nails, and sandpaper; an assortment of different kinds of metal, wood, and wire; visual equipment such as blueprints, large drawings on window shades, slides and movies; several finished projects at different stages of designs; a panel showing the project at different stages of construction, etc. In other words, any type of teaching aid which will assist the teacher in putting the information across to the pupils. By having these items listed in the master plan, a teacher can tell at a glance just what is needed for the demonstration.

Daily Plan of Teaching

This is one of the most important parts of the demonstration plan. It has been discovered that it is folly to demonstrate a complete job at one sitting. The span of attention for a group of pupils is usually 10 to 15 minutes. A teacher should, therefore, plan each demonstration or discussion so that it will take approximately that long. Furthermore, if a teacher demon-

(Continued on page 52A)

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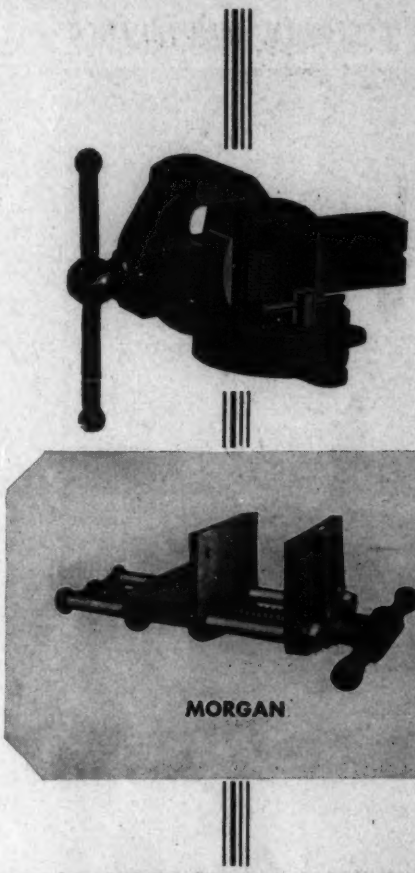
Fine Tools Are Indispensable to Sound Training

Until students have *actually worked with* these swift, versatile, modern tools, they can have no comprehension of the vast difference such tools make in speed, good workmanship, high earning power. Tools that are the accepted standard throughout industry . . . *the choice of better mechanics* everywhere . . . are the logical choice for the training of the productive craftsmen of the future. • To vocational schools throughout America Snap-on offers the services and counsel of tool experts, located in principal cities from coast to coast. We will gladly send the Snap-on catalog of 3,000 hand and power tools on request. Address, SNAP-ON TOOLS CORPORATION, 8074-C 28th Ave., Kenosha, Wisconsin.

Snap-on Tools
THE CHOICE OF BETTER MECHANICS



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MORGAN VISE CO.

120 N. Jefferson St. Chicago 6, Ill.

(Continued from page 48A)

REAMER — spindle bolt
REAMER SETS
- *a*) Piston pin, ½ in. to 1⅜ in.
- *b*) Taper pin
- *c*) Valve seat

SAWS
- *a*) Hack, frames, 10 in., adjustable
- *b*) Hack-saw blades, 18, 20, and 24 teeth
- *c*) Hand

SCALES
- *a*) Steel, 6 in., graduated 1/64 and 1/100 in.
- *b*) Steel, 12 in., graduated 1/32 in.

SCRAPERS
- *a*) Bearing
- *b*) Carbon

SCREW DRIVERS
- *a*) 6 in. and 12 in.
- *b*) Small combination

SCREW EXTRACTORS
SCRIBERS
SNIPS — tin, 3 in. straight and 3 in. curved
SOLDERING COPPERS — 1, 2, and 3 lb. with handles
SPRING SPREADERS
STAMPS
- *a*) Figures, 3/16 in.
- *b*) Letters, 3/16 in.

TAP-AND-DIE SETS
- *a*) Machine screw
- *b*) N.F. ¼ in. to 1 in.
- *c*) N.C. ¼ in. to 1 in.

TIRE TOOLS
TOOL KIT — metal box or canvas roll, empty
TWIST DRILLS — (extra sets) selected sizes
VALVE
- *a*) Grinders (hand)
- *b*) Spring lifters

WRENCHES
- *a*) 8 in., 10 in., 12 in., and 18 in.
- *b*) Ignition sets
- *c*) Pipe, 10 in., 14 in., 16 in., and 18 in.
- *d*) Rim socket
- *e*) Socket sets, large assortment with case
- *f*) Spark plug
- *g*) Speed wrenches
- *h*) Standard end sets, ¼ in. to ⅞ in., N.C. and N.F.
- *j*) Valve-tappet wrenches

Automotive Shop— Materials and Supplies

ABRASIVE CLOTH AND PAPER — aluminum oxide and silicon carbide
ACETYLENE GAS — in drums, for welding
ACID
ALCOHOL
BABBITT
BEARING BLUE
BEARING COMPOUND
BOLTS
- *a*) Machine, selected sizes
- *b*) N.F., selected sizes
- *c*) Stove, flat or round heads, selected sizes

BRAKE JUICE — ½-pt. cans
BRUSHES
- *a*) Paint
- *b*) Spark plug
- *c*) Spoke
- *d*) Steel
- *e*) Varnish

CHAMOIS
COIL-SPRING ASSORTMENT
COPPER TUBING
COTTER PINS — assorted sizes
CROCUS CLOTH
DISTILLED WATER
DRAIN COCKS
ELECTROLYTE
ENAMEL — AUTO PAINTING
GASKETS
- *a*) Copper asbestos
- *b*) Cork and felt
- *c*) Flange

GASOLINE
GREASE — cup, cans
KEROSINE
KEYS, WHITNEY — assorted
LACQUER — colors
LEAD
LUBRICANT — transmission
NAILS AND BRADS
NUTS
- *a*) N.F., castellated, square, hexagon, selected sizes and kinds
- *b*) N.C., square and hexagon, selected sizes
- *c*) Machine screw, selected sizes
- *d*) Wing, selected sizes

OIL
- *a*) Cylinder, light, medium, and heavy
- *b*) 600W
- *c*) Penetrating

OXYGEN — in drums for lead burning
PIG LEAD
PISTON-RING COMPRESSORS
RADIATOR HOSE
RIVETS — brake lining, 5/16 in., ½ in., and ¾ in. long.
SCREWS
- *a*) Flathead or roundhead, iron or brass, selected sizes and kinds
- *b*) Cap and machine, iron, or brass, selected sizes and kinds

SEALING COMPOUND
SHELLAC — ½-pt. cans
SHIM STOCK
SOAPSTONE
SOLDER — bar, wire, or self-fluxing wire
SOLDERING PASTE
SPELTER — for brazing
SPONGES — ¾ lb.
STARTING CABLE
TACKS AND STAPLES — upholstery
TIRE
- *a*) Carcass fabric
- *b*) Cushion stock
- *c*) Inner-tube repair stock
- *d*) Patching cement
- *e*) Patches
- *f*) Putty
- *g*) Tread stock
- *h*) Vulcanizing

VALVE-GRINDING COMPOUND — coarse and fine
WASHERS
- *a*) Lock, assorted sizes
- *b*) Wrought iron

WASTE
WIRE — primary and secondary

Send for Your FREE Copy

K&W NEW COMPLETE LINE CATALOG

TEACH THE MECHANICAL METHOD PRINCIPLES THAT MAKE CRACKED ENGINE REPAIRS EFFICIENT AND ECONOMICAL

If you want to be up to date on engine repairs, you'll want your copy of Kerkling & Company's new K & W catalog—and you'll want it fast. There's a big special section with illustrations and diagrams devoted exclusively to the "how" and "why" of the patented K & W Mechanical Method—the efficient, time and money saving way that is guaranteed to restore cracked automotive and diesel engines to unimpaired service.

The war has more than proved the effectiveness and economy of repairing cracked engines the easy K & W way. No engine repair course is complete without knowledge of this method—used extensively by leading engine rebuilders, fleet operators, railroads and military repair centers.

NATIONALLY ADVERTISED— K & W products are advertised in Liberty, Popular Science and Popular Mechanics as well as in leading Automotive Trade Journals.

Tools required to make K & W Mechanical Method repairs are the type of portable power tools that are standard equipment in most school shops. Remember—all K & W literature plus complete training for Vocational Instructors is available without charge!

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School.....

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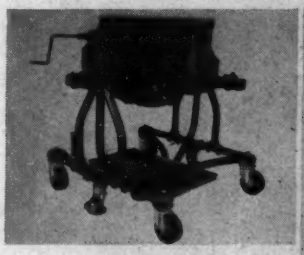
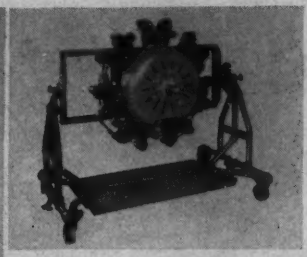


Universal Model AC-15—For all Bus, Truck, Tractor and Automotive Engines up to 1500 lbs. weight.

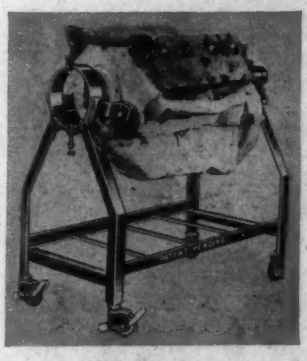
Universal Model 201—For all in-line Automotive Engines up to 600 lbs. weight.



Aircraft Model AC-1B—For all makes of radial, in-line and horizontally opposed Aircraft Engines up to 225 H.P.

THESE AUTOMOTIVE & AIRCRAFT ENGINE STANDS FILL A WANT AND MEET A NEED IN CLASSROOM AND SHOP

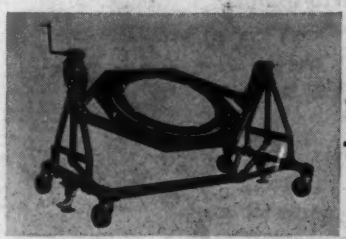
All are Mobile—Safe—Sturdy—Economical



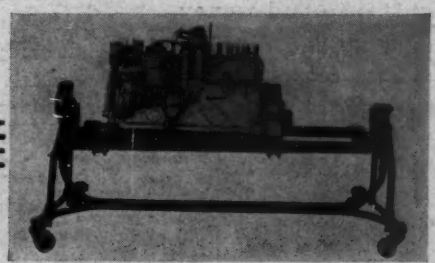
Ford V-8 Stand—For Ford V-8, 60, 85, 90, 95 & 100 Engines.

Vocational schools are finding these Clayborne Engine Stands of great value in classroom and shop because, in addition to their mobility, safety, sturdiness, and low cost, their design permits accessibility to the complete engine for rebuilding or demonstrating.

Write Clayborne Manufacturing Company, Dept. 1, 209 S. La Salle St., Chicago 4 Illinois, for completely illustrated descriptive literature on any or all of these Stands. In Canada, address James B. Carter, Ltd., Winnipeg.



Aircraft Model AC-5—Primarily for radial Aircraft Engines up to 2000 cubic inches.



Universal Model AC-4—(with fully enclosed worm drive) For all Automotive Engines up to 3000 lbs. weight.

(Continued from page 48A)

strates too many operations or discusses too many topics at one time, the pupils will become confused and as a result a majority retain little, if any, of the information presented. The material which a teacher is going to cover in presenting a project should, therefore, be divided over a period of several days. For example, if a teacher is going to demonstrate the use of the coping saw, sandpapering, and drilling of holes in building a project, it is better to demonstrate the use of the coping saw one day, how to sandpaper the second, and how to lay out and drill holes the third day. A brief statement of the work to be covered each day is sufficient. The daily plan of teaching should include an introduction of the job, demonstrations on the various operations, discussions on the technical information, and the test.

Drawing or Sketches

Drawings or sketches are essential for any type of a teacher's plan. The drawings used may be a working drawing, views showing the layout of various parts, details of construction, or a blueprint which can be attached to the master demonstration plan. In some cases the drawings may be views that the teacher would have the students sketch into their notebooks. Whatever the case may be the master demonstration plan is a convenient storage space for this information.

Steps in Doing the Job

The steps in doing the job consist in a written analysis of the procedure to follow when building the project. The statements should be short and to the point. By starting each statement with the verb, the best results can be obtained.

In every series of steps there are some steps that are more important than the others. It is desirable to have these difficult steps checked by the foreman or teacher as the boy completes them. When the pupils write the steps into their planning book, it is well to indicate these steps that have to be checked by drawing a circle around the number preceding the step. By having a line drawn from the circle out into the margin, space is provided for the foreman or instructor to sign his initials when that part of the job has been completed.

If the teacher is having the pupils plan their work, the procedure that the teacher writes should not be used. The steps in doing the job that are suggested by the students as the teacher demonstrates the job should be placed into the pupil's planning book.

Reference

No matter how thorough a job of teaching an individual does, it is impossible to get all of the information across to every student. Some of this knowledge can best be obtained by having the pupils read it. A short reference should be selected from some reliable book. This reference should be on material which is in connection with the job being taught. In selecting this reference be sure that it covers one of the high points in the lesson.

To make sure that the students have read the assignment the following three methods are suggested. The student should be requested to answer oral questions that are asked him by the teacher when he hands in the finished project for a final mark. The student may be furnished a list of questions which he can answer only by reading the reference. There are often questions included in the reference book thrat the student should be required to answer in writing.

Standard or Average Time

Our present-day teacher has come to the conclusion that projects cannot be marked on quality alone, but that time should also be taken into consideration. With that in mind, the average time necessary for a group of boys to do a selected project must be established. As you can readily understand, this length of time cannot be established when the teacher first introduces the job, but can be determined after a majority of the boys have completed the project. Until then the teacher will have to use an estimated standard time.

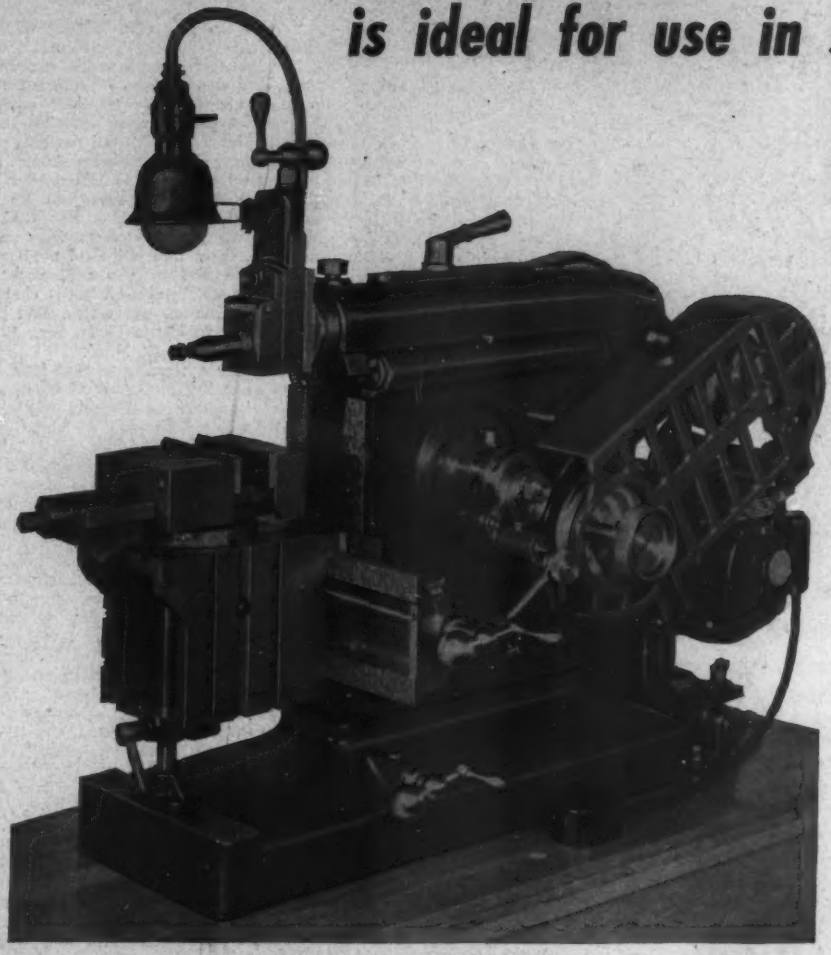
The Unit Test

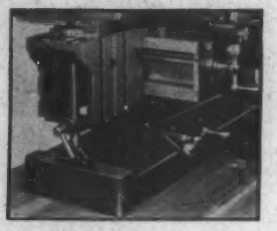
A unit test is given at the completion of the series of lessons on the selected project. This test is an inventory of the knowledge the pupil has acquired from the demonstrations and discussions. It is also a check on the teacher to see if he did a good job of

(Continued on page 58A)

AMMCO 7" PRECISION SHAPER

is ideal for use in school shop!





★ Has "VEE" Type Ways, comparable to those of large, expensive shapers.

★ Handles a wide variety of work.

★ Portable Model is mounted on maple cabinet.

Students quickly acquire ability to produce accurate work on this precision machine

Leaders in school shop instruction unreservedly recommend the AMMCO 7" PRECISION SHAPER. It is small in size, but it is mighty in efficiency and precision... It incorporates all important features of larger machines selling for hundreds of dollars more than the Ammco . . . and users of the Ammco tell us "it's the finest made". . . Simplicity of operation, plus special safety features, make this machine ideal for student use. A wide variety of work can be done on this shaper, and as one instructor has said —"it is a precision machine of a thousand uses."

Made for bench installation, or as a portable unit.

Write today for specifications and prices

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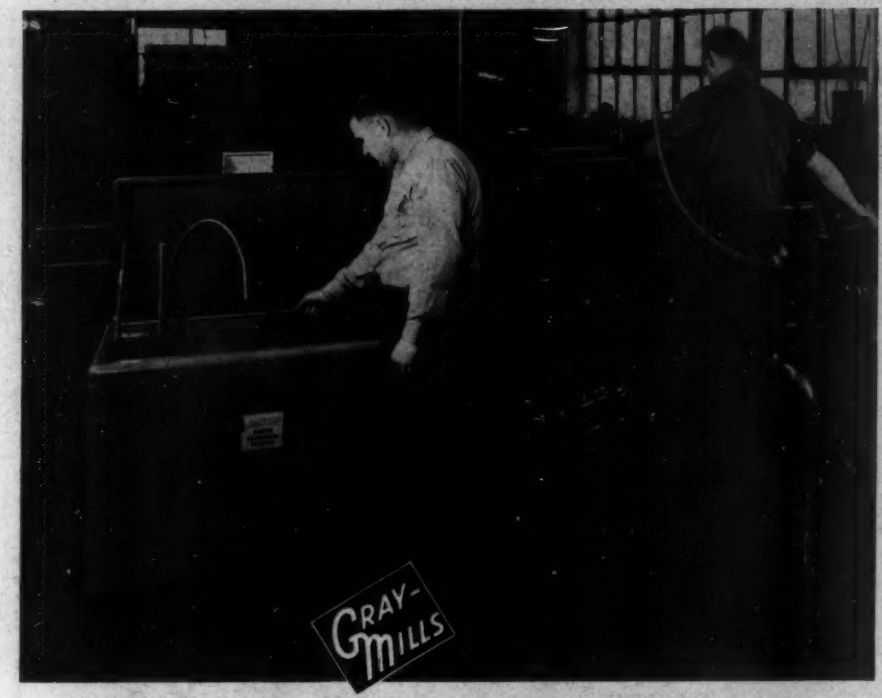

NEW AGITOR PARTS CLEANING SYSTEM

Cold Cleans 4 Better Ways

Removes Cutting Oils, Greases, Lubricants and Sludges . . . for Machine Shops, Metal Shops, Auto Shops and Tool Rooms

Only AGITOR gives you 4 cleaning actions . . . each with a definite function to clean faster . . . more efficiently . . . unattended in operation.

AGITOR is easy to use...add Gray-Mills' Agitene Solvent, plug in, set to desired action and it's ready for your cleaning job.

MODEL H-71, illustrated, has . . . Swisher Basket, Bottom Rack and Screen, Air Agitator, 2 Control Valves, Shelf, Cover Safety Device, Centrifugal Pump (600 gallons an hour cap.), included in a reinforced, heavy-gauge steel housing.

AGITOR'S 4 BETTER WAYS OF CLEANING
Action at the Twist of a Wrist

1. **SWIRLING AGITATION**—Flushing action of solvent in tank cleans soaking parts.
2. **FOUNTAIN SURGE AGITATING**—Surging fountain cleans parts in "basket".
3. **HI-VOLUME HOSE CLEANING**—Direct the semi-flexible hose to parts . . . cleans unattended.
4. **AIR AGITATION**—Entire tank of solvent may be air agitated for faster cleaning action.

Write for information on AGITOR Parts Cleaning Systems, Solvents, Pumps, and Coolant Systems.

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News Notes

♦ Kodachrome slides, more than 1500 in number, showing life in Central and South American Republics, are now available on loan to schools and colleges, it was announced recently by the Division of International Educational Relations, U. S. Office of Education, Federal Security Agency.

The 2 by 2-in. slides are in natural color, and may be projected from a standard size slide projector. Sets of slides for 33 different titles are now available for free loan on request. Each set will be accompanied by teacher's notes giving information relating to the subjects shown on each slide. Slides are mounted between glass and shipped in a small wooden box.

The loan period is three weeks. The borrower assumes the responsibility for the safe return by parcel post of each set borrowed.

Requests for loans of slides should be addressed to U. S. Office of Education, Division of International Educational Relations, American Republics Section, Washington 25, D. C.

♦ The American Mercury announces a series of radio scripts on current problems entitled "Script-of-the-Month." Each script is based on an article in the magazine. It is written as a 15-minute round-table discussion with simple dialogue for four speakers. The following subjects are now available: (1) Does America Need a Strong England?, (2) Will Germany Try it Again?

These scripts have a variety of uses. It may be presented on the air as an actual broadcast, on a P.A. system as a school broadcast, in the auditorium as an assembly program, in club meetings as a panel discussion, in classrooms as part of the lesson material.

A free copy of each script may be obtained by writing to Radio Department, The American Mercury, 570 Lexington Ave., New York 22, N. Y.

♦ The U. S. Office of Education has announced the release of 41 new training films on precision wood machining, covering many specific subjects from the simplest skills necessary to operate a wood lathe to the complex problems faced by an experienced patternmaker.

Ten of the new films dealing with an experienced patternmaker's problems show how a patternmaker "thinks through" a particular problem, how he analyzes specifications, considers possible methods, weighs their advantages and limitations, decides upon the best method, then designs and constructs the pattern.

The films, all of which are 16mm. sound, were produced for the U. S. Office of Education by the Jam Handy Organization, Detroit; Photo and Sound, San Francisco; and R.C.M. Productions, Hollywood. Accompanying each film is a 35mm. silent film strip and a 12-page teaching guide. The film strips are $1 each; the teaching guides are furnished without charge.

For information about titles and prices of the films, write to Castle Films, Inc., 30 Rockefeller Plaza, New York 20, N. Y.

♦ Returning from overseas duty and finding private industry in a snarl of strikes or threatened strikes, veterans are flocking to the U. S. Civil Service Commission, 433 W. Van Buren St., Chicago 7, Ill., in the hope of obtaining federal employment where strikes are impossible.

While many vacancies still exist in government employment they are in the main for individuals with special qualifications such as legal training, accounting, personnel specialists, training officers, chemists, draftsmen, engineers, and salesmen who deal in industrial equipment.

However, our doors are open to any veteran to take examinations for any job in our classified register. While an opening for the job he elects may not exist at the time he applies he may register for the job. When an opening does occur the three names of the highest qualifications will be taken from the register for consideration. One of the three will be selected, and all factors being considered, including a physical examination, an appointment will follow. The other two names will be returned to the register for the next request to fill a vacancy.

Except in the case of disabled veterans, all appointments are for war service only. This means that appointments are either temporary or indefinite, not to remain longer in effect than six months after peace has been officially declared.

The reason for this arrangement is to give veterans still overseas the same opportunity for government positions as those who are now here.

All those holding war service appointments who wish to continue in government work will eventually be obliged to retake their examinations in competition with the returning veterans.

Information about government jobs and application forms may be obtained from local U. S. Civil Service secretaries stationed at first- and second-class post offices.

Veterans who have been discharged with records showing 10 per cent or more service-connected disability are the only ones eligible for examinations for permanent appointment. The government policy is to give impaired veterans the highest priority, adapting the employment to the physical ability of the veteran to perform his duties according to his limitations.

♦ The Mergenthaler Printing Vocational High School has expanded its courses to a four-year basis.

♦ The Dunwoody Institute, Minneapolis, Minn., offers vocational training for those who want to enter the fields of newspaper and commercial printing.

♦ A complete reorganization of the industrial-arts department at State Teachers College, Chadron, Neb., has been announced. New courses to be added are sheet metal, machine shop, and electric and gas welding.

♦ The new film, "Concrete Facts," tells the story of cement dispersion, and shows how the durability of concrete can be increased as much as 500 per cent.

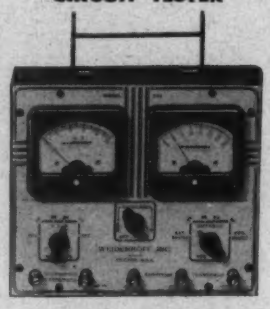
High lights in the film are the results of studies of cement dispersion conducted by the research

(Continued on page 60A)

WEIDENHOFF B&E SERVICE TOOLS

If you want to make that budget for new automotive electrical testing and service equipment do its best, buy Weidenhoff equipment. Why not equip your school with the same products that have made such an enviable reputation in the trade? Some of the products that will simplify your teaching are shown below.

CIRCUIT TESTER

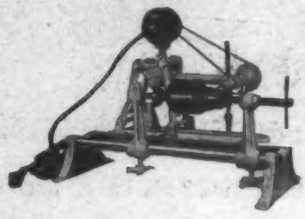


Makes possible quick tests and adjustments of generators within the voltage and current limits of the voltmeter and ammeter. Exact generator output is shown. Current draw of headlights, radio or ignition coil easily checked as well as voltage drop across any switch or wire .

POLE PIECE SCREWDRIVER

For instantly removing or replacing the most stubborn generator or starting motor pole piece screw without damaging parts. Pole pieces are easily pulled into position by the tremendous torque applied at the screw head.

UNDERCUTTER



Undercuts commutators up to 6" diameter. Centers adjustable up to 18". Vee-blocks for centerless armatures. Sturdy steel horizontal support with machined keyway assures alignment and parallel movement.

PULLER PRESS

A quick-acting arbor and puller press. Used for removing and replacing bearings, bushings, races, slip rings and caps. Puller Plate has suitable opening for every job, including the small magneto bearing races .

Classroom use of Weidenhoff equipment is one of the surest ways of teaching modern engine and automotive electrical system maintenance. The equipment is accurate, rugged, modern in design, with over 30 years of recognized achievement in the field. Everything your school shop needs from a battery hydrometer to a complete generator test bench. Better plan now to meet greater teaching demands with Weidenhoff products.

WEIDENHOFF PUBLICATIONS:

Handbook of Engine Maintenance — Battery Charging — Fast Battery Charging — Magnetos — Magnet and Rotor Recharging — Engine Tune-up — Generators and Starting Motors — Armature Testing — Ignition Distributors, and others. Full information available.

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YOU DON'T USE A SLEDGE TO DRIVE TACKS

There was a time when machine tools had to be heavy to be accurate but modern engineering and manufacturing methods have changed that. Today, the fully equipped shop has its big lathes for big work, and SHELDON S-56 Precision Lathes for small parts. With accuracy that will hold the closest tolerances and the stamina to stand up to continuous high speed operation, these smaller, handier, moderate priced lathes are cutting the cost of and increasing the hourly output of small turned parts.

From Any Angle A Better Lathe

Write for the new condensed catalog showing these new, modern, lighter, faster machine tools.

SHELDON MACHINE CO., INC.
4244 N. Knox Ave., Chicago 41, U.S.A.

GLOSSARY FOR FILM USERS

Some of the terms which the officials of the Encyclopaedia Britannica Films, Inc., believe every teacher using classroom films should know:

A.c. Alternating current. Usually 60 cycles.

Amplifier. The vacuum-tube system (like radio) which magnifies the sound impulses.

Animation. Cartoons or technical drawings which are made to move on the screen.

Aperture. The frame size opening in the projector which permits the light to strike the film and project it through the lens.

Base (safety). The celluloseacetate film material which supports the photographic image.

Bead. Tiny glass particles on the surface of a "beaded screen" to increase the light-reflecting power.

Booking. The reservation of films or equipment for a definite screening date.

Bloop. The peculiar sound issuing from the loud-speaker when a film splice passes through the projector.

Blooping. The lacquering of a film splice to eliminate the sound of the "bloop."

Cement. The solvent material used to hold two strips of film together. Used in splicing.

Condenser. The immovable lense in the projector between the lamp and the film. They condense diverging light beams into parallel rays.

Cut. The place where one scene in a film stops and another scene starts without any "tricks" (fades or wipes).

D.c. Direct current. Most projectors operate on a.c. You may need a convertor if current is d.c.

Dissolve. The place where one scene in a film dissolves into the following scene.

Emulsion. The gelatin with imbedded silver which forms the film image.

Exciter. The lamp which shines through the sound track to the photoelectric cell in the sound projector.

Fade. The place where one scene of a film gradually fades into or out of view.

Frame (noun). A single complete scene on the film.

Frame (verb). The centering of the scene on the screen. Done by turning a small knob or lever on the projector.

Frequency. The value scale of sound tones such as high, low, and medium. Measured in kilocycles.

Fuse. A small, low-melting-point wire in a projector which melts and stops the current flow if too much electricity enters the projector, or if a short circuit develops.

Gate. The hinged retainer plate which holds the film firmly against the aperture in a projector.

Gelatin. The gelatinous coating on the film base which holds the silver image.

Image. A photographically obtained likeness on a film emulsion.

Narration. See Voice Over.

Oscillograph. A testing device to check the frequency of vibration and hence the capability of an amplifier in handling various frequencies.

Polarity. The direction in which electric current flows. D.c. projectors must receive current in the right direction. Wrong polarity can be corrected by withdrawing and reversing position of the plug.

Reel (spool). A spool on which film is wound and capable of being put onto a projector. Can be for any film capacity whatever.

Reel (of film). A unit of film length (400 ft. of 16mm. film). 1, 2, 3, 4, or any fractional number of reels can be wound on a reel (spool).

Release. A generic term for films intended for general distribution or exhibition.

Rewind (noun). A cranking device for winding film on a reel (spool).

Rewind (verb). To wind a film after it comes off the projector onto another reel so that the title is at the outside (loose end) and the film is ready for re-showing.

Sound Track. The portion of the film (edge) on which the sound is recorded. It may be of varying degrees of density, or of varying area of clear stock with black borders.

Splice (noun). The place where two strips of film overlap and are cemented together.

Splice (verb). To make a splice of two strips of film.

Sprocket. The toothed wheels on the projector which engage the film and guide or pull it through the machine.

Sprocket Holes. The holes along the edge of film that are engaged by the sprocket wheels of the projector. Silent films have them on each edge. Sound films on one edge only.

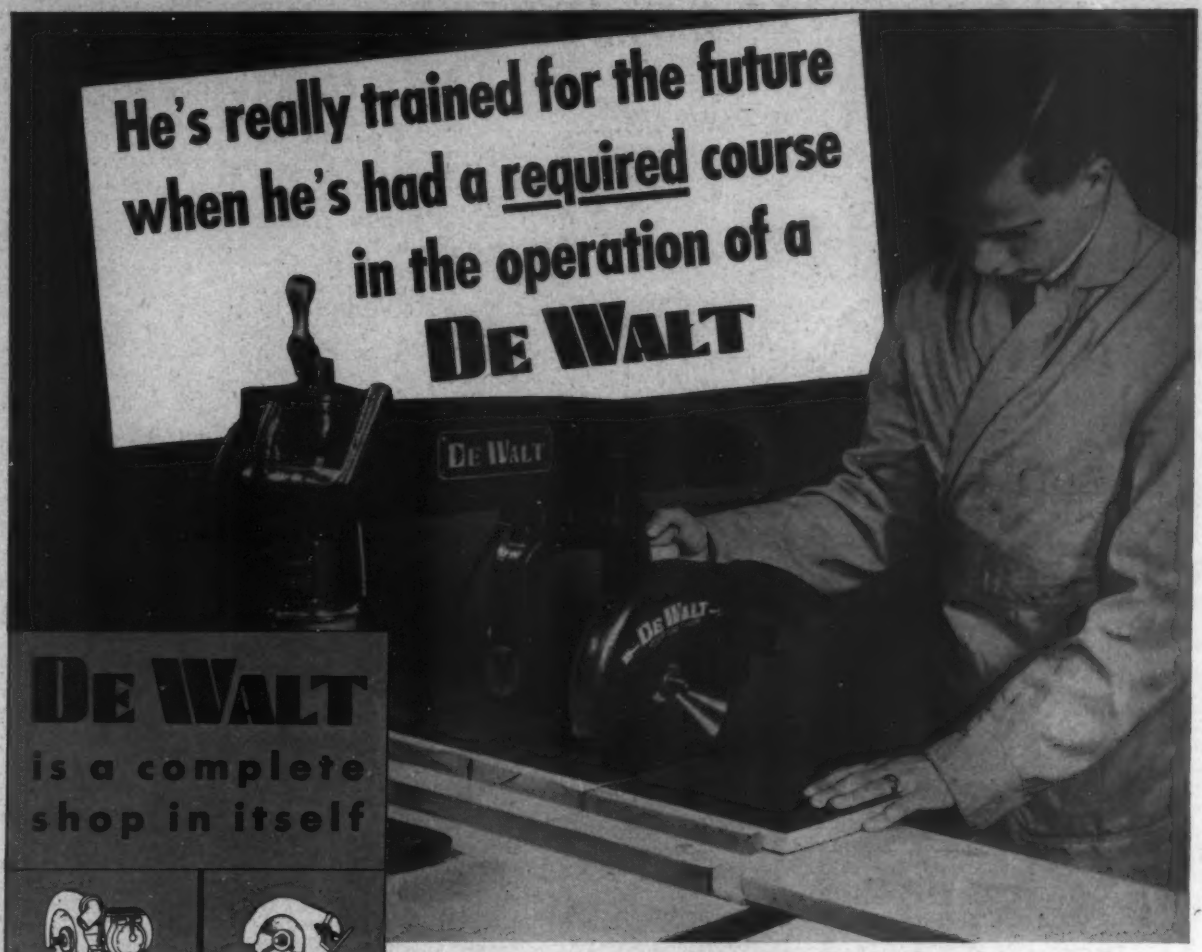
Stroboscope. A Neon lamp and rotating disk testing device to check the speed of projectors.

Stock Film. Consists of the base and an emulsion of gelatin and silver.

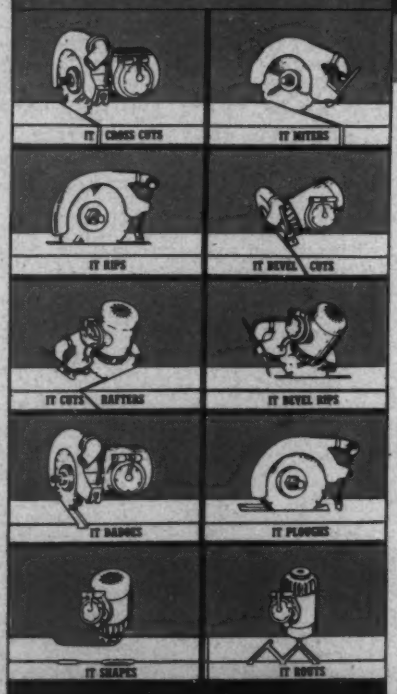
Trick. Any method used to end one scene and begin another. Also any method of having

(Continued on page 66A)

He's really trained for the future when he's had a required course in the operation of a DE WALT



DE WALT is a complete shop in itself



...and with proper tools makes any cut possible!

After the student has completed his basic training course in the use of hand tools, he should have a *required* course in the operation of DeWalt.

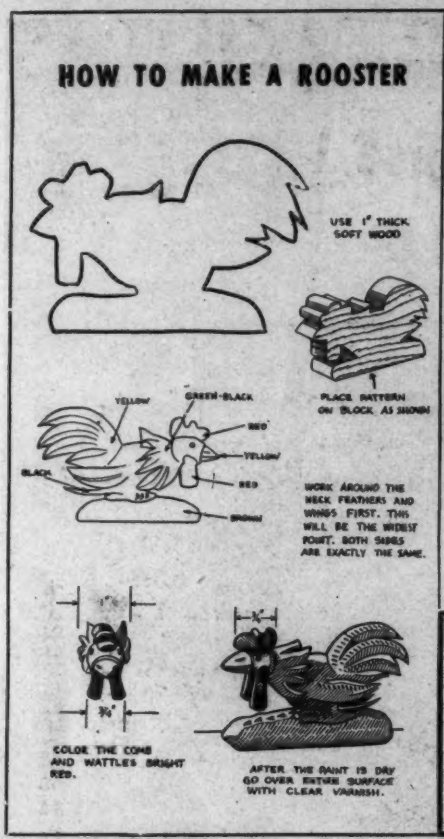
Knowing how to make the fullest use of this flexible, easy-to-operate machine, will give any student a head-start as he prepares for tomorrow's industry.

When he leaves school he will be fully acquainted with a machine that is destined to occupy a prominent place in tomorrow's industry. The perfection of the DeWalt saw has created new methods in cutting wood, making obsolete old-style equipment previously used.

We urge you to investigate DeWalt. *Install* DeWalt in your school.

16 MM SOUND MOVIES—"DeWalt Saws in the War Program" and "The Standard DeWalt Machine." These are the only sound movies on woodworking machinery now being used by vocational teachers as part of their regular training courses. Write for details.

DEWALT PRODUCTS CORPORATION
123 Fountain Avenue **Lancaster, Penna.**


HOW TO MAKE A ROOSTER
USE 1" THICK SOFT WOOD
PLACE PATTERN ON BLOCK AS SHOWN
YELLOW
GREEN-BLACK
RED
YELLOW
BLACK
RED
BROWN
WORK AROUND THE NECK FEATHERS AND WINGS FIRST. THIS WILL BE THE WIDEST POINT. BOTH SIDES ARE EXACTLY THE SAME.
COLOR THE COMB AND WATTLES BRIGHT RED.
AFTER THE PAINT IS DRY GO OVER ENTIRE SURFACE WITH CLEAR VARNISH.

You'll Have Plenty To CROW About!

Look How Easy It Is To Whittle A Rooster With Your Handy X-acto Knife

You can make a whole menagerie of clever wooden animals. All you need is a hunk of soft white pine (yep, it's to be had again) and your trusty X-acto. *And* a copy of that helpful 32-page booklet, "Whittling Is Easy With X-acto". (25 fun-to-make projects.) Send 10c for a copy, and start carving. You'll be whittling like an expert in practically no time.

A Blade For Every Cut

This Whittler's Set includes an all-metal X-acto Knife, with an assortment of five extra blades, all scalpel-sharp and quickly interchangeable. Firm-grip handle, designed for safety and precise control. Complete with wooden chest, $2. Other X-acto Knives and Knife Chests, 50c to $5.

X-acto KNIVES & TOOLS

Buy where you see this sign. At your Hardware, Hobby or Art Supply Shop

Or if not available, write direct to X-acto Crescent Products Co., Inc., 440 Fourth Avenue, New York 16, N. Y.

*Reg. U. S. Pat. Off.

(Continued from page 52A)

teaching. Furthermore, the test is a teaching aid in bringing out the important points in the lessons.

The test should be of the objective type. The types that function the best are the true and false, direct answer, multiple choice, and matching. Approximately ten questions should be written for each master demonstration plan. The tests are administered by the teacher reading the questions to the class. The students write the answer into the space that has been provided in their planning book. When multiple choice or matching questions are used the choices should be listed on the blackboard prior to the test.

The marks the boys receive on a test should be incorporated into the mark he receives on the finished project.

The master demonstration plan works very well in connection with "The Student's Plan of Work," as described by Baysinger and Silvius in their article which appeared on pages 147–149 in the INDUSTRIAL ARTS AND VOCATIONAL EDUCATION Magazine of April, 1945, and also with various student planning books that are now available.

MASTER DEMONSTRATION PLAN

Tie Rack

A. Instructional Units Involved

Operations

1. Measure with a rule
*5. Sand wood surfaces
6. Lay out a design
12. Drill holes
*13. Saw a curve
14. Fasten with screws
17. Glue up stock

Technical information

*A. Plan a procedure
C. Make a bill of material
*F. Kinds and uses of common woods
*G. Kind and size of coping saws
*H. Kinds and uses of sandpaper
I. Kinds and sizes of drills
J. Kind and sizes of wood screws
L. Kind and uses of glue

B. Tools and Equipment Necessary to Do the Job

1. Coping saw
2. Templets
3. Hand drill
4. 5/32 drill
5. Miter box and saw
6. 3/32 drill
7. Screw driver
8. Sanding block
9. Awl

C. Materials Necessary to Do the Job

1. 5/16 Basswood S2S 4½ x 8½
2. ½ Dowel rod 1 in. long
3. Sandpaper
4. Two No. 7–1 in. r.h.b. wood screws
5. Glue

D. Items Other Than Tools and Materials Needed by Teacher

1. Several finished tie racks of different designs
2. Panel showing detailed parts of assembly
3. Several grades of sandpaper
4. Several drills of different sizes
5. Samples of different kinds of wood
6. Display of coping saw frames and blades
7. Display of wood screws

E. Daily Plan for Teaching

1. Introduce the job to be taught, discuss the value of making a tie rack, what the boys will learn, and common kinds of wood.
2. Demonstrate laying out of tie rack and how to use a coping saw. Discuss different kinds of coping saws and blades.
3. Demonstrate how to sandpaper; discuss kinds of sandpaper.
4. Demonstrate how to assemble the tie rack; discuss kinds of drills, glue, and screws.
5. Give the test.

F. Drawings or Sketches

G. Steps in Doing the Job

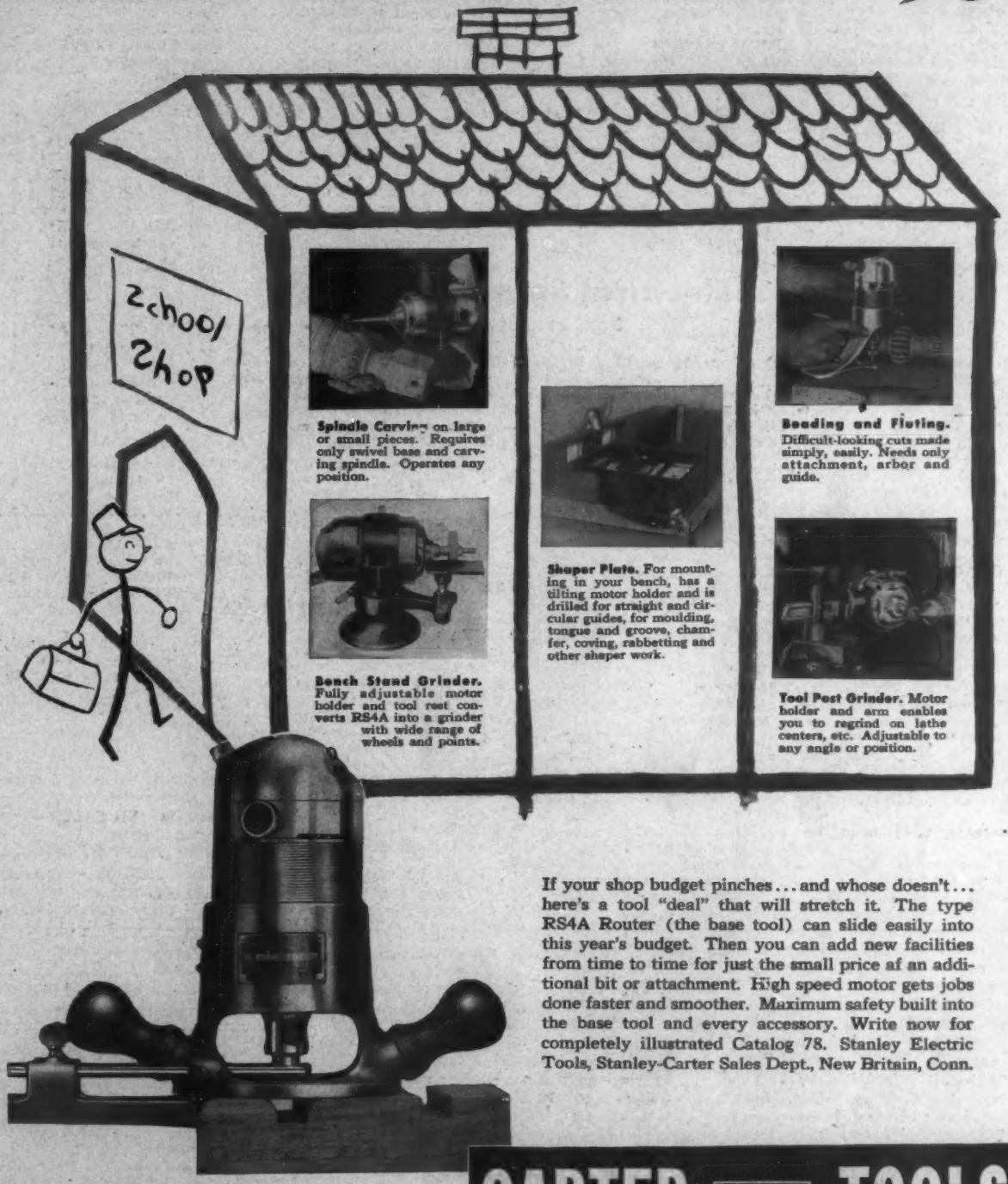
1. Obtain wood
—(2) Lay out with templets
3. Saw out with coping saw
—(4) Sandpaper

(Continued on page 60A)

*Points that teacher wants to stress.

Fig. 2. Sample master demonstration plan

How to get BIG SHOP FACILITIES into a SMALL SHOP BUDGET



Spindle Carving on large or small pieces. Requires only swivel base and carving spindle. Operates any position.

Bench Stand Grinder. Fully adjustable motor holder and tool rest converts RS4A into a grinder with wide range of wheels and points.

Shaper Plate. For mounting in your bench, has a tilting motor holder and is drilled for straight and circular guides, for moulding, tongue and groove, chamfer, coving, rabbetting and other shaper work.

Beading and Fluting. Difficult-looking cuts made simply, easily. Needs only attachment, arbor and guide.

Tool Post Grinder. Motor holder and arm enables you to regrind on lathe centers, etc. Adjustable to any angle or position.

If your shop budget pinches... and whose doesn't... here's a tool "deal" that will stretch it. The type RS4A Router (the base tool) can slide easily into this year's budget. Then you can add new facilities from time to time for just the small price af an additional bit or attachment. High speed motor gets jobs done faster and smoother. Maximum safety built into the base tool and every accessory. Write now for completely illustrated Catalog 78. Stanley Electric Tools, Stanley-Carter Sales Dept., New Britain, Conn.

CARTER STANLEY TOOLS

Electrical - Shop Equipment, Supplies, and Motor Testing Equipment

These maximum lists may be found helpful in checking inventories or preparing budgets.

If possible, each shop should have access to a projector, so that stills, silent movies, or sound movies, may be used also in the student's industrial arts and vocational education courses.

BENCH GRINDER
BENCHES — plain or with drawers, for tools and equipment, or with compartments for the storing of wiring panels. Preferably they should have electrical outlets
BITS
- a) Auger, ¼ in. to 1 in. by 16ths
- b) Auger, 11/16 in., 18 in. long
- c) Drill, for wood, square shank, ⅛ in. to ½ in. by 16ths
- d) Expansion
- e) Extension, 18 in.
- f) Screw driver, ¼ in.

BLACKBOARD — permanent or portable
BLOWTORCHES — 1-qt. size
BOOKCASE
BRACES — ratchet type, 8-in. swing
BULLETIN BOARD
CABINETS — wood or metal for filing class records, instruction sheets, drawings, etc.
CHAIRS — teacher's and tablet arm
COMPASS SAW
COIL
- a) Spreader
- b) Taper
- c) Winder

DESK — teacher's, with drawer compartments
DRILL
- a) Breast
- b) Concrete, ⅜ in., ½ in., ¾ in., 1 in.
- c) Hand
- d) Portable, electric
- e) Twist, 1/32 in. to ⅜ in. by 32nds

DRILL PRESS
- a) Bench, hand, or power driven
- b) Heavy, power driven

FILES
FIRST-AID CABINET AND SUPPLIES
HACK SAW
- a) Blades, 10 in., 24 tooth
- b) Frames, adjustable

HAMMERS
- a) Claw, 12 oz.
- b) Machinist's, ball peen

HICKEY — ½ in. and ¾ in.
LATHE
- a) Engine, 10-in. or 12-in. swing, 6 ft. or 8 ft. long
- b) Speed

PLIERS
- a) Gas, 6½ in. and 8 in.
- b) Side cutting, 6 in.

PUNCH — for metal molding
PUNCHES — assorted
REAMERS
- a) Pipe burring, ¼ in. to 1 in.
- b) Pipe burring, ½ in. to 2 in.

RULES
- a) 48 in. zigzag
- b) 72 in. zigzag

SCREW DRIVERS — 3 in., 5 in., and 8 in.
SHEARS — for cutting metal molding
SOLDER DIPPERS
SOLDERING COPPERS
- a) Assorted
- b) Electric
- c) Handles

STOCKS AND DIES — for pipe threads, ½ in. to 1 in.
VISES
- a) Machinist's, 4 in.
- b) Pipe

WRENCHES
- a) Adjustable, 6 in. and 8 in.
- b) Pipe, 10 in., 12 in., and 14 in.
- c) Socket, combination

Electrical Shop—Supplies

ABRASIVE CLOTH — Aluminum oxide, 1, 1½, and 2 in. wide
ARMORED CABLE
- a) 2 wire, No. 14, single strip
- b) 3 wire, No. 14, single strip
- c) Box connectors

ATTACHMENT PLUG
BAR HANGERS
BATTERIES — dry cells
BATTERY ACID — 1.300
BATTERY SEALING COMPOUND
BOX CLEATS
BRADS — ¾ in., No. 19, and 1¼ in., No. 16
BRAKE LINING — ¼ by 2 in.
BRUSHES — carbon, for motors and generators
BURGLAR CONTACTS
- a) Open circuit
- b) Closed circuit

BUSHINGS
- a) Loom, No. 1 and No. 2
- b) "Jiffy" loom No. 2

BUZZERS
CLEATS — unglazed porcelain, 2 wire
CLIPS — test, with insulators, Universal, Nos. 22, 23, 24, and 25
COMMUTATOR CEMENT
CONDUIT
- a) Bushings, ½ in., ¾ in., and 1 in.
- b) Box connectors, for flexible
- c) Couplings, for flexible
- d) Lock nuts, ½ in., ¾ in., and 1 in.
- e) Rigid, ½ in., ¾ in., and 1 in.

CONDULET
- a) Fillings, ½ in., LL, LR, and LB
- b) Covers, ½ in., blank

DOOR OPENERS — mortised
FISH PAPER — .0125 in. thick
FIXTURES — brass chain, suspension
FIXTURE STUDS
FUSES
- a) Plug type, renewable, 125 volt, 15 amp.
- b) Cartridge type, renewable, 125 volt, 30 amp.
- c) Renewals for plug fuses
- d) Renewals for cartridge fuses

GROUND CLAMPS — ⅜ in. to 1 in., assorted
HICKEY GRIPS — ½ in. and ¾ in.
LAMPS
- a) Carbon, 220 volt, 60 watt
- b) Mazda, selected as wattages and voltages
- c) Guards for brass sockets

LEATHER NAIL HEADS
LUGS — 25 and 50 amp.
LUMBER — 2 by 4 in. by 14 ft., No. 1, white pine dressed, 4 sides
MOLDING
- a) Metal
- b) Metal, fittings — crosses, T's, internal elbows, junction boxes, switch bases, keyless receptacles, snap switches

NAILS — roofing
NUTS — iron, 4-36, 6-32, 8-32, 10-24, 12-24, 10-32, 14-20
OUTLET BOXES — 4 in. square, with one round blank cover, and one cover with bushed opening
PIPE STRAPS — galvanized, ⅜ in., ½ in., ¾ in., and 1 in.
PUSH BUTTONS
- a) Return call, 3 point
- b) Single

RECEPTACLES
- a) Flush, duplex
- b) Porcelain cleat, 660 watt, 250 volt
- c) Concealed
- d) Covers

RECTIFIERS — Tungar, for charging from 1 to 12, 6- and 12-volt batteries
RELAYS — Dixie
RESISTANCE BOARDS — for testing
RESISTANCE UNITS — 125-ohm
RHEOSTATS
- a) Compression, 275 watt
- b) Field, for shunt and compound motors

ROSETTES — wood
ROTARY CONVERTER — 5-kw. capacity, 3 phase a.c., 110 volt d.c.
SCREWS
- a) Anchors, 8/32, 10/24, 12/24, 14/20
- b) Machine, roundhead, 4-36 by ¼ in., 6-32 by ½ in., 6-32 by ¾ in., 8-32 by ⅜ in., 8-32 by ½ in., 8-32 by 1 in., 10-32 by ⅜ in., 10-24 by ⅜ in., 10-24 by ¾ in., 10-32 by ¾ in., 12-24 by 1 in.
- c) Machine, brass, roundhead, 4-36 by ¼ in., 6-32 by ½ in., 6-32 by ¾ in., 8-32 by ½ in.
- d) Wood, flathead bright, No. 5 by ¾ in., No. 8 by ½ in., No. 8 by ¾ in., No. 8 by 1 in., No. 7 by 1½ in., No. 8 by 1½ in., No. 7 by 2 in.
- e) Wood, roundhead blued, No. 7 by 1 in., No. 8 by 1½ in., No. 10 by 1½ in., No. 7 by 2 in.

SLEEVING — No. 1, white; No. 1, blue; and No. 1, red
SOCKETS
- a) Brushed, brass pull chain, keyless, key
- b) Porcelain, keyless, with caps
- c) Porcelain, key, with caps

SOCKET CAPS — ¼ in. and ⅜ in. bushed
SOLDER WIRE — 50/50, size No. 10
SOLDERING PASTE — 2 oz. cans, noncorrosive
SOLDERING SALTS — 1-oz. cans, noncorrosive
SPEED COUNTERS — 0-9999
SPLIT KNOBS — porcelain
SPRING BALANCES — 0-30 lb.

(Continued on page 62A)

(Continued from page 58A)

5. Saw off two pieces of ½ in. dowel rod ½ in. long
6. Drill 5/32 holes in support and dowels
7. Drill 3/32 holes in back

—(8) Assemble with glue and screws

H. References

General Shop Woodworking, by Fryklund and LaBerge, pp. 39–40 and 45–47 (Bloomington, Ill.: McKnight and McKnight).

Basic Woodworking Processes, by Herman Hjorth, pp. 46–47 and 209–211 (Milwaukee, Wis.: The Bruce Publishing Co.).

I. Standard Time

Seven days.

J. The Seven Days Unit Test

This is a true and false test. If you know the answer is true place a C in your planning book. If you know the answer is false place an X.

1. The teeth of the coping saw blade should point toward the handle.
2. The length of a piece of wood is always with the grain.
3. End grain is sanded in two directions.
4. When sanding the edge or end grain, it is well to place the board in a vise.
5. A brace is used to operate a drill.
6. R.H.B. stands for roundhead blue.
7. The side of a coping saw blade is held at an angle of 45 degrees to the wood.
8. When applying glue to small objects use a small applicator.
9. No. 1 sandpaper is finer than No. 0.
10. The hand that is holding the wood should be outside the V of the coping saw jack or back of the saw blade.

KEY FOR UNIT TEST

1. C	4. C	7. X	10. C
2. C	5. X	8. C	
3. X	6. C	9. X	

NEWS NOTES

(Continued from page 54A)

department of Ohio State University and the findings of a two years' investigation by the nation's highest testing authority.

For information about the film, address The Master Builders Co., 7016 Euclid Ave., Cleveland 3, Ohio.

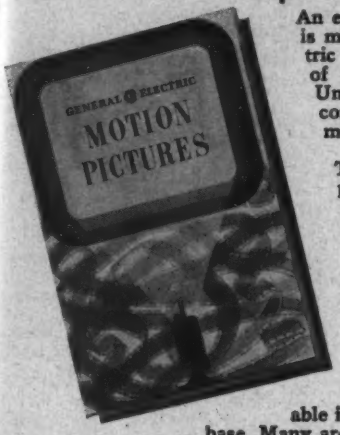
The American Bankers Association, 12 E. 36th St., New York 16, N. Y., is urging the state bankers associations in the 48 states and the District of Columbia, to work closely with their

(Continued on page 64A)

GENERAL ELECTRIC EDUCATIONAL SERVICE

General Electric recognizes that the future welfare of industry and of the country depends upon adequate training of today's students for tomorrow's tasks. It is the policy of the Company to aid the faculties and students of our schools and colleges in every way possible.

Motion-picture Films



An extensive motion-picture service is maintained by the General Electric Company for the purpose of disseminating throughout the United States reliable information concerning important developments in the electrical field.

The service provides motion-picture films by means of which the details of manufacture and the use of electric products are presented in a highly instructive manner.

Silent pictures are furnished either in 35-mm, safety or nitrate stock, and 16-mm safety stock.

All sound pictures are available in 16-mm sound on film, safety base. Many are also available in 35-mm size. Films are lent free of charge with transportation charges paid by user.

These films are listed and described in General Electric's motion-picture catalog, GES-402, copies of which may be had upon application to the nearest G-E office. Requests for the use of motion-picture films should be addressed as directed in that publication and will receive the attention of a specialist.

Photo News Service

General Electric furnishes more than 10,000 school and college teachers in this country and abroad with semimonthly news posters which tell briefly, authoritatively, and interestingly the story of the accomplishments of electricity — the most recent developments in the research laboratories of the Company — experiments with man-made lightning — electric ships, spectacular lightning, precision instruments, short-wave radio, x-ray. These posters have come to be almost standard equipment for many general-science teachers. They are published on the 1st and 15th of every month from October 1 through June 15. The service is free. Teachers only should apply for it, and should give their school address.

Educational Construction Projects

The General Electric Company, in carrying out its educational program, has sponsored the preparation and publication of several construction projects for technical and vocational schools. These projects are exceptionally valuable for the school shop since they are not merely assembly projects, but involve a certain amount of mechanical dexterity with such tools as the lathe, drill press, tap and die, etc. Some G-E projects and their descriptive bulletins are listed below — others are in preparation:

(1) ¼-hp, single-phase, 60-cycle, 110-volt capacitor-motor, GEA-3514.

(2) ½-hp, single-phase, 60-cycle, 115/230-volt capacitor-motor, GEA-3526.

(3) ½-hp, 3-phase, 60 cycle, 220-volt motor, GEA-3542.

(4) 250-watt, 125-volt, compound-wound d-c generator.

(5) 1½-kva, 220-55/110-volt, 60-cycle air-cooled transformer, GET-569.

Equipment for Electric-machinery and Electronics Laboratories

When deciding on the equipment for an electrical shop or laboratory, the new Bulletin GED-1093 will be particularly useful. In this publication will be found equipment listed in several groups to meet a wide range of requirements. For the elementary courses, a few of the more important types of machines are recommended, together with control apparatus, measuring instruments, and certain machine tools which should be in every electrical shop. For more advanced work, or as funds become available, equipment from other groups may be added to provide well-balanced laboratory equipment which will permit a wide range of experiments.

In addition to listing the equipment, this booklet discusses briefly the several items, explaining why they have been selected and the use to which they may be put in the laboratory.

This bulletin, which supersedes GEB-62, has been completely revised and brought up to date. The section covering electronics-laboratory equipment is especially recommended to those who are planning a laboratory for the study of the basic principles of electronics and electronic control.

LABORATORY APPARATUS

General Electric engineers will gladly recommend apparatus to meet your special conditions if you will give them such details as: type of course, number of students, laboratory or shop space available, money at hand for equipment, etc. Further than this, liberal discounts from the regular commercial prices of Company products are allowed to educational institutions. For quotations on apparatus and further information concerning G-E educational service, consult the Educational Specialist at the nearest office of the Company, or write direct to our Educational Service Division at Schenectady.

Usually, the General Electric Company recommends standard apparatus for laboratory instruction. It is recognized, however, that because of its size, cost, and the power required for operation, much commercial apparatus cannot be used in the laboratories of engineering schools and colleges. For this reason, the General Electric Company has given especial attention to the selection for educational use of such standard apparatus as is of suitable size and which will illustrate fundamental principles of design and construction as well as acceptable commercial practice.

Where standard apparatus is not entirely suitable, the General Electric Company has not hesitated to design special apparatus for the electrical laboratory and shop.

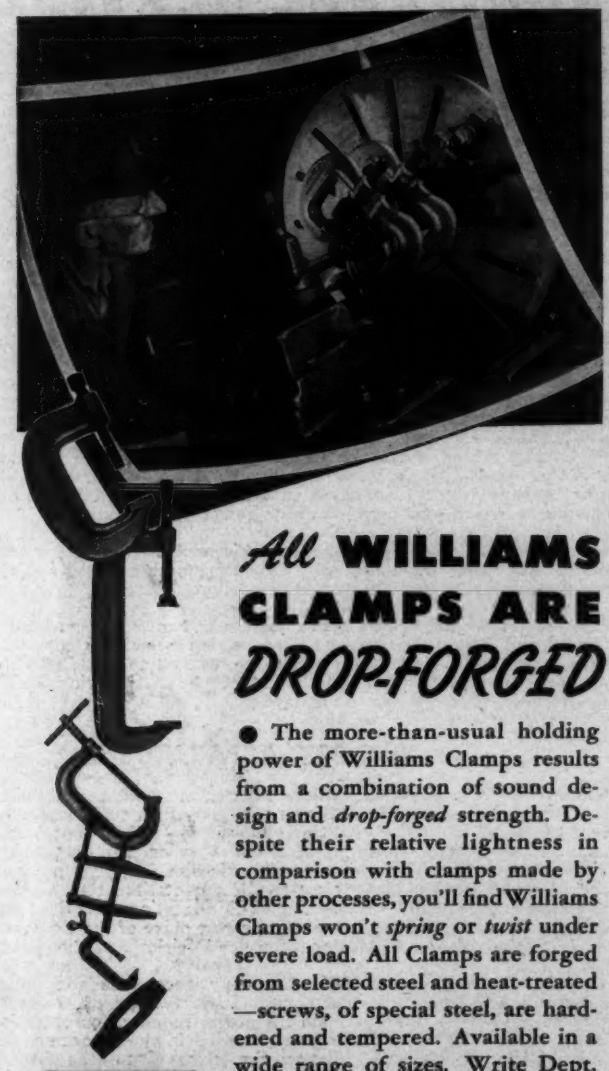
Thus the student is given an opportunity, while becoming familiar with the underlying principles of electrical engineering, to become acquainted with actual construction details. Bulletin GEA-1185 illustrates and describes G-E apparatus particularly adapted for laboratory use.

Other G-E- Publications

Catalogs, descriptive bulletins, and other publications are available covering practically all standard lines of G-E apparatus, such as electric motors and generators, control equipment, instruments, transformers, etc. For such bulletins and for complete information regarding any electric equipment in which you are interested, address the Educational Specialist at the nearest G-E office.

GENERAL ELECTRIC

General Office, Schenectady, N. Y. — Apparatus Sales Offices in Principal Cities



All WILLIAMS CLAMPS ARE DROP-FORGED

● The more-than-usual holding power of Williams Clamps results from a combination of sound design and *drop-forged* strength. Despite their relative lightness in comparison with clamps made by other processes, you'll find Williams Clamps won't *spring* or *twist* under severe load. All Clamps are forged from selected steel and heat-treated —screws, of special steel, are hardened and tempered. Available in a wide range of sizes. Write Dept. I-346 for descriptive literature.

Free DATA SHEETS

J. H. WILLIAMS & CO.
400 VULCAN ST., BUFFALO 7, N. Y.

Mailed postpaid on request — Order by number.

1. Data on "Superior" Wrenches.
2. Data on Boring Tools.
3. Data on Chain Pipe Tongs.
4. Data on "Supersocket" Wrenches.
5. Data on Lathe Dogs.
6. Data on Chain Pipe Vises.
7. Data on Turning Tools.
8. Types of "Superior" Wrenches.
9. Use of "Supersocket" Wrenches.
10. Data on Eye Bolts.
11. Data on "C" Clamps.
12. Use of Cutting-Off Tools.
13. Use of Knurling Tools.
14. External Thread Cutting.
15. Internal Thread Cutting.
16 to 21. Six Data Sheets on grinding cutters for Tool Holders.
22. Use of Open-end Wrenches.
23. Use of Lathe Dogs.
24. Use of Socket Wrenches.

(Continued from page 60A)

STARTING BOXES
- *a*) For compound motors, various makes
- *b*) For shunt wound, 1 h.p., 110-volt motors. Overload release
- *c*) For shunt wound, 1 h.p., 110-volt motors. No voltage release
- *d*) Starting devices of various makes and principles, for 1 h.p., 3-phase, 220-volt a.c. motors

STORAGE BATTERIES — 6 volt

SWITCH
- *a*) Battery, 4 point
- *b*) Bases, porcelain, for 10-amp. switches
- *c*) Boxes, 2¾ in. deep
- *d*) Entrance, safety, 2 pole, 30 amp., with 2-branch lighting circuits
- *e*) Entrance, safety, 3 pole, 30 amp., 250 volt
- *f*) Flush, push button, S.P., D.P., 3 way, 4 way
- *g*) Surface, S1, S3, and S4
- *h*) Knife, type A, D.P.S.T., D.P.D.T., S.P.S.T., and S.P.D.T.
- *j*) Surface, snap, electrolier
- *k*) Surface, snap, S.P.D.P., 3 way, 4 way

SWITCHBOARD — as required

TACKS — double-pointed No. 10

TAPE
- *a*) Friction, ½-lb. rolls
- *b*) Rubber, ½-lb. rolls

TELEGRAPH SETS — including sounders, keys, and relays

TELEPHONES
- *a*) Complete bridging, independent phones
- *b*) Couch vestibule telephones
- *c*) Receivers, transmitters, induction coils, condensers, and bridging switch hooks

TRANSFORMERS
- *a*) Bell ringing, 6, 8, 14 volt
- *b*) Single phase, 110–220 volt, S.K.V.A.

TUBES — porcelain, 5/16 by 3 in., 5/16 by 5 in., and 5/16 by 10 in.

TUBING — flexible nonmetallic, ¼ in. and ⅜ in.

WASHERS
- *a*) Iron, ¼ in. and ⅜ in.
- *b*) Brass, ¼ in. and ⅜ in.

WIRE
- *a*) Annunciator No. 18 or No. 20
- *b*) Fixture, No. 18, single yellow, with marker
- *c*) Rubber covered, solid copper, No. 10, black
- *d*) No. 10, white
- *e*) No. 14, black
- *f*) No. 14, white
- *g*) Rubber covered, No. 16, brewery cord
- *h*) No. 18, lamp cord, green and yellow
- *j*) S.C.C. copper magnet, enameled, sizes Nos. 16 to 26 inclusive

Electrical Shop— Motor and Testing Equipment

ANNUNCIATORS
- *a*) Automatic needle drop
- *b*) Gravity drop
- *c*) Manual needle drop

ARMATURES — burnt out, for repairing

BATTERY CHARGER — commercial

CIRCUIT BREAKERS
- *a*) Air, single pole, overload, 25 amp., 550 volt
- *b*) Air, single pole, underload, 15 amp., 550 volt

CONTROLLERS
- *a*) For multiple-speed motor
- *b*) For 1 h.p., 110-volt series motors

GENERATORS
- *a*) Motor-generator set, 10 h.p., to supply 110-volt d.c. for testing purposes, battery charging, etc.
- *b*) Generator, 6-volt d.c. coupled to an a.c. motor for 6-volt circuit testing
- *c*) Auto generators of different makes

GRAVITY CELLS

MAGNETS — testing, 10,000 ohm

METERS
- *a*) Ammeter, standard, 60 amp., a.c.
- *b*) Ammeter, standard, 60 amp., d.c.
- *c*) Ammeter, student, 60 amp., a.c.
- *d*) Ammeter, student, 60 amp., d.c.
- *e*) Voltmeter, standard, 0–10 volt,
- *f*) Voltmeter, standard, 110–220 volt, d.c.–a.c.
- *g*) Voltmeter, standard, 125 volt, a.c.
- *h*) Voltmeter, standard, 125 volt, d.c.
- *j*) Voltmeter, student, 110 volt, d.c.
- *k*) Voltmeter, student, 110 volt, a.c.
- *l*) Wattmeter, standard, 110–220 volt, 30–60 amp., d.c.–a.c.
- *m*) Wattmeter, student, 110–220 volt, 30 amp., a.c.–d.c.
- *n*) Watt-hour meter, 125 volt, 5 amp., a.c., single phase, various makes

MOTORS
- *a*) Auto starter, different makes
- *b*) Burnt out, fractional h.p., 110 volt, 60 cycle, for repairing
- *c*) Compound, 1 h.p., 110 volt, d.c.
- *d*) Multiple speed, 1 h.p., 3 phase, 220 volt
- *e*) Series, 1 h.p., 110 volt, d.c.
- *f*) Shunt, 1 h.p., 110 volt, d.c.
- *g*) Split phase and repulsive, a.c., 110 volt, single phase, assorted
- *h*) Split phase induction motors, fractional h.p., 110 volt, 60 cycle, different makes
- *j*) 3 phase, 1 h.p., a.c., 220 volt, various makes
- *k*) 3 phase, 2 h.p., 220 volt, a.c., various makes
- *l*) Universal, fractional h.p., 110 volt, different makes
- *m*) Universal, variable speed, ⅓ h.p.

PLATFORM SCALE — 100 lb. capacity

The World's STANDARDS OF ACCURACY

for Instruction, Research, Industry

The widespread use of WESTON instruments in vocational education has become a fixed principle...primarily because these are the measurement standards so widely used throughout industry. Thus the student becomes thoroughly familiar with the instruments he will use throughout his industrial career. They are preferred, too, because they inspire students to be more exacting in their work, and because they represent a truly sound investment...combining ruggedness, dependability and long life.

Following is a condensed listing of the WESTON instruments available . . . also are illustrated a few of the models most widely used in educational work. Complete information on any WESTON instrument is available and will gladly be sent on request. Write to . . . Weston Electrical Instrument Corporation, 595 Frelinghuysen Avenue, Newark 5, New Jersey.

PORTABLE INDICATING INSTRUMENTS
Ammeters, Voltmeters, Wattmeters, Galvanometers, Microammeters, Ohmmeters, Microfarad Meters

PANEL MOUNTING INSTRUMENTS
Ammeters, Voltmeters, Wattmeters, Galvanometers, Microammeters, Ohmmeters, Microfarad Meters

RELAYS
Sensitive and Power Uses – Current and Voltage Types

INSTRUMENT TRANSFORMERS
Portable – Potential and Current

AIRCRAFT INSTRUMENTS
Tachometers, Temperature Indicators, Radio Compass Indicators, Ammeters, Voltmeters, etc.

ELECTRIC TACHOMETERS
A.C. and D.C. Types – Remote Indicating

LABORATORY STANDARDS
Voltmeters, Ammeters, Wattmeters

SPECIALIZED TESTING EQUIPMENT
Power Analyzer, Photoelectric Potentiometer, Battery Testing Instruments

SERVICE EQUIPMENT
Tubecheckers, Analyzers, Ohmmeters

PHOTOELECTRIC CELLS
"Photronic" Cells – Dry Disc Type

PHOTOELECTRIC CONTROL DEVICES
"*Photronic" Illumination Controls

LIGHT MEASURING DEVICES
Illumination Meter, Foot Candle Meters, Sight Meter, Exposure Meters

TEMPERATURE INDICATING INSTRUMENTS
ELECTRICAL TYPE – Remote Indicating
BIMETALLIC DIAL TYPE – Laboratory, Industrial

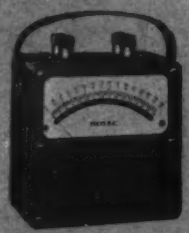
INSTRUMENT ACCESSORIES AND PARTS
Shunts, Cables, Resistors, Switches, Binding Posts, Leads, Multipliers, Adapters, Radio Plugs, etc.

STANDARD CELLS

**Photronic—A registered trademark designating the photoelectric cells and photoelectric devices manufactured exclusively by the Weston Electrical Instrument Corporation.*

Model 703
Sight Meter

Direct-reading pocket size meter calibrated to measure light values in foot-candles, and "seeing tasks." Equipped with Weston VISCOR filter it measures the visual intensity of all common lighting sources without correction factors.



Model 430
Portable, Precision A. C. and D. C. Instruments

Universally used in schools and industry wherever rugged, portable instruments are required for general testing. Hand calibrated, mirror scales with knife-edged pointers.

Model 779 Type 1
Super-Sensitive Analyzer

Small, light, sturdy . . . has 25 carefully selected voltage, current, resistance and decibel ranges. Ideal for measurements in tube circuits, transmitters, electronic controls, audio and communications equipment, condenser leakage, etc., etc. D.C. sensitivity 1000 or 20,000 ohms per volt.

Model 375
Student Galvanometer

Ideal for schools, where durability and moderate cost are essential. Sensitivity approximately 22 microamperes per division, resistance about 23 ohms. Zero center scale, calibrated 30-0-30 in millimeter divisions. Other sensitive models also available.

Model 280
Miniature D. C. Instruments

Miniature precision D.C. instruments, with hand calibrated mirror scales and knife edged pointers. Available as voltmeters, ammeters, volt-ammeters, milliammeters and millivoltmeters.

Model 777 Type 7A
Tubechecker

Provides total emission test, and has individual switch for each tube element. Thus each element can be connected to test circuit regardless of tube base used now, or in future. Tests all tubes . . . individual electrode test . . . neon short check . . . cathode leakage . . . line voltage control . . . load tests.

WESTON *Instruments*

Model 489 and 528
Small A. C. and D. C. Instruments

Small, sturdy, inexpensive . . . for all-around A.C. and D.C. testing where moderate accuracy is sufficient. Available in Voltmeters, Ammeters, Milliammeters. A.C. models available in single, double and triple ranges.

THE ROOT and TRUNK of Productive Industry Is DESIGN

A leading airplane manufacturer advertises *design* as the reason for airline preference for its ships . . . a treasured rug is valued for its visible *design* of beauty and its enduring *design* of warp and woof . . . a machine tool, an intricate screw machine product, a bound and printed book, ad infinitum . . . all depend upon and spring from *design*.

Aluminum Copper, Silver

Leather

Plastics

Tools and equipment for the accomplishment of projects in aluminum, copper, silver, leather, plastics, and other media are described in Fellowcrafters' 60-page illustrated catalog.

3538. RAWHIDE MALLET, 2" diam. Accepted type and of sufficient weight for easy smooth-surface forming of metals. Does not mar. Ea. $1.45; Doz. $15.95.

3601. PLASTIC MALLET, 1½" diam. 5 oz. head. Craftsman can grind shape and polish to suit own ideas. Ea. $1.70; Doz. $18.00.

3527-A. METAL FORMING HAMMER, Steel. 16 oz. Proper design for all metal forming. Both ends highly polished. Ea. $2.50; Doz. $27.50.

112. LEATHER PUNCH. Superior construction with parallel jaw action. 8" length provides good leverage for easy operation. 6 tubes. Positive, adjustable spacing guide. Ea. $5.00; Doz. $55.00.

CHIP CARVING KNIVES. American-made from finest knife steel. 5½" overall. Exposed blade 2¼".

2804-A. SLICING KNIFE. Ea. $1.00; Doz. $11.00.

2805-A. STICKING KNIFE. Each $.90; Doz. $9.90.

NEW AND USEFUL CHART OF ABRASIVES SHOWING KINDS AND USES . . . FREE ON REQUEST

Distributors' Warehouse Stocks In 27 Cities

ANCHORAGE, ALASKA, Fred G. Kohli
ATLANTA 1, GA., Milton Bradley Co. of Ga., Inc., 384 Forrest Ave., N.E.
BOISE, IDAHO, The Book Shop, 319 N. 8th St.
BOSTON 15, MASS., Gledhill Bros., Inc., 663 Beacon St. unt St.
BOSTON 16, MASS., Fellowcrafters, Inc., 130 Clarendon St.
CEDAR FALLS, IOWA, J. S. Latta & Son.
CHICAGO 10, ILL., Chicago Craft Service, Craft House, 615 No. Lasalle St.
CINCINNATI 2, OHIO, The A. E. Wilde Co., 136 W. 7th St.
CLEVELAND 13, OHIO, Cleveland Leather Co., 1817 W. 25th Street.
DALLAS 1, TEX., Handicraft Supply, 409 No. Akard St.
DENVER 2, COLO., H. R. Meininger Co.,409 Sixteenth St.
DETROIT 26, MICH., Dearborn Leather Co., 834 Michigan Ave.
EL PASO, TEXAS, Foskett Leather Co., 208 So. Stanton St.
HONOLULU, HAWAII, T.H., N. K. Young Co., 7 No. Pauahi St. (P. O. Box 1656).
INDIANAPOLIS, IND., Kiger & Co., 52-54 W. New York St.
LOS ANGELES 55, CAL., Schwabacher-Frey Co., School Supply Division, 736-738 So. Broadway.
LOUISVILLE 2 KY., Central School Supply Co., 311 W. Main St.
NASHVILLE 3, TENN., Nashville Products Co., 158 2nd Ave., N.
NEW ORLEANS 15, LA., National Craft & Hobby Shop, 5835 Magazine St.
NEW YORK, N. Y., New York Central Supply Co., 62 Third Ave.
NEW YORK 7, N. Y., Warren Sales Co., Inc., 26 Park Pl.
OKLAHOMA CITY 2, OKLA., Dowling's, Second and Broadway.
PHILADELPHIA 6, PA., Garrett-Buchanan Co., School Supply Dept., 12-20 So. 6th St.
PHOENIX, ARIZ., Peterson-Brooke-Steiner & Wist, Div., Amer. Seating Co., P.O. Box 551.
PORTLAND 4, ORE., J. K. Gill Co., 408 S. W. 5th Ave.
RICHMOND 20, VA., Flowers School Equipment Co., 327 W. Main St.
ST. PAUL 1, MINN., St. Paul Book & Stationery Co., 55-57-59 East Sixth St.
SALT LAKE CITY 1, UTAH, Utah Idaho School Supply Co., 155 So. State St.
SYRACUSE 2, N. Y., Bardeen's, Inc., 543-45 E. Genesee St.
CANADA, TORONTO, 2B, Lewis Craft Supplies, Ltd., 8 Bathurst St.

Fellowcrafters INC. 130 CLARENDON ST. BOSTON 16, MASS.

(Continued from page 60A)

state departments of education to set up adequate requirements for "on the job" training programs for veterans who will return to their employment in banks or who desire to enter banking.

Since formal apprentice training programs are generally lacking in the financial field, there is an apparent inadequacy of examination by state departments of education in the training programs of such organizations. The establishing of proper standards for bank training institutions thus becomes a responsibility of the state bankers associations, which are urged to co-operate with their state departments of education to formulate such standards. The state associations are also urged to co-operate with their state departments of public education in setting up "essentials" of a bank apprentice training program and to confer with their district councilmen or associate councilmen of the American Institute of Banking and with officials of A.I.B. chapters on the use of formal banking courses as activities that should supplement bank apprentice training programs.

♦ The release of a complete series of training films on plastics was announced today by the U. S. Office of Education, Federal Security Agency.

The new films, 10 in number, are 16mm. sound, and are accompanied by 35mm. silent filmstrips and teacher's manuals. Filmstrips are obtainable for one dollar each; the manuals are furnished without charge.

The films may be purchased from visual education dealers or direct from Castle Films, Inc., 30 Rockefeller Plaza, New York 20, N. Y. Schools will receive a 10 per cent discount.

♦ Four leading engineering colleges have been selected by the National Safety Council to develop programs for the training of industrial safety engineers. They are the Illinois Institute of Technology, Georgia School of Technology, the Engineering College of the University of California, and the College of Engineering at New York University.

Each of these institutions represents an important geographical section of the nation and, to a considerable degree, varying industrial interests. Operating on a grant from the National Safety Council, the four institutions will be responsible for the administration of a program suited to the industrial needs of the region it serves.

It is proposed that the work at each institution be developed along the following lines:

1. Integrate safety into all regular engineering courses where applicable.

2. Reorganize and re-equip all laboratories and shops so as to incorporate true safety practice as a proper example to all students.

3. Develop in co-operation with industry in the several areas a program of safety engineering on the graduate level for engineering graduates who have been out in industry and have become active and interested in safety work.

4. Endeavor to enhance the standing and reputation of the profession of safety engineering not only by limiting such graduate professional training to those who first qualify as engineers but also to attempt, by whatever means possible to increase the professional stature of those men who by virtue of long experience and practice in the field are justified in now using the title safety engineer.

New Publications

Introduction to Practical Radio

By D. J. Tucker. Cloth, 322 pp., 5⅞ by 8⅝ in., illus. Price, $3. The Macmillan Co., New York City.

This is a text that is helpful to students as well as to the practicing radio engineer and technician.

While it covers no more than the first principles of the subject, it does it in a very thorough manner.

There are numerous problems which bring out many phases of electrical theory. Tables of logarithms; natural trigonometric functions; powers, roots, and reciprocals; have been made a part of the book. There also are short glossaries on mathematics and electricity.

Education for Action

By Willard W. Beatty, Director of Education, United States Indian Service and Associates. Cloth, 347 pp., 7⅜ by 10½ in. Price, $2. Published by the Education Division, United States Indian Service.

This book presents reprints of 175 of the leading articles originally published in "Indian Service" over a period of seven years.

These articles have been gathered under 14 chapter headings among which are the following: Some of the Ways We Teach; Problem Solving Through Guidance; Humanizing Institutional Living; Utilizing Regional Resources; and Indian Arts and Crafts.

The material presented, while originally designed for the Indian educational service, contains much that is very helpful in the field of rural education.

Wartime Relations of the Federal Government and the Public Schools, 1917–18

By Lewis Paul Todd. Cloth, 240 pp., 6⅛ by 9⅛ in. Price, $3.15. Published by the Bureau of Publications, Teachers College, Columbia University, New York, N. Y.

A study to show how the Committee on Public Information, which directed the propaganda during the last war, was able to use the schools to arouse patriotism, further the idea of military training for high-school students, increase the attention paid to physical training in schools, and to influence students to work on farms during vacation time in order to increase food production.

The influence of the war on child labor, and on the teaching personnel of the country also is pictured.

Some Principles for Evaluating Shorthand Systems

By Marsdon A. Sherman. Paper, 70 pp., 5½ by 8½ in. Price, $1.25. King's Crown Press, Morningside Heights, New York, N. Y.

A study containing much interesting information about the establishment of the principles for evaluating efficiency factors, how the evaluation formulas are developed, and the summary and conclusions arrived at in this study.

Mathematics for Technical and Vocational Schools

Third Edition. By Samuel Slade and Louis Margolis. Cloth, 532 pp., 5¼ by 7¾ in., illus. Price, $2.50. John Wiley and Sons, New York City.

This is the third edition of this mathematics book which contains numerous problems that are applicable in machine-shop classes.

It covers arithmetic, algebra, geometry, and trigonometry. The book also contains tables of powers, roots, circumferences, and areas; logarithms; natural trigonometric functions (to the nearest minute) on sines and cosines, tangents and cotangents, secants and cosecants; weights of materials, and other helpful tabulated information.

Industrial Algebra and Trigonometry

By John H. Wolfe, William F. Mueller, and Seibert D. Mullikin. Cloth, 389 pp., 5⅜ by 8¼ in., illus. Price, $2.20. McGraw-Hill Book Co., New York 18, N. Y.

A book in which the fundamental operations of algebra, factoring, fractions, equations, exponents and radicals, simultaneous linear equations, quadratic equations, systems of equations, radical equations, as well as trigonometry, logarithms, oblique triangles, analytic trigonometry, higher degree equations, and compound angles are embodied in practical problems and presented in a clear manner. The problems are illustrated by good line etchings. Toolmakers and advanced machinists will be delighted with this book.

Tables on the natural trigonometric functions

(Continued on page 68A)

OLIVER

Woodworking Machines

Hollow Chisel Mortiser

Junior Model Oilstone Tool Grinder

Disk Sander

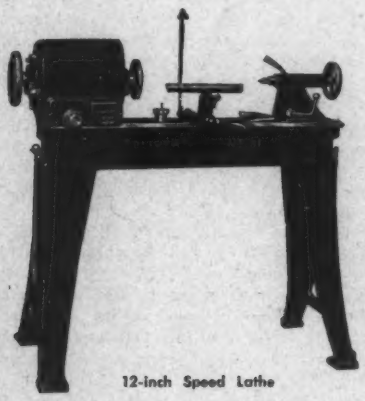
Double Arbor, Motor Arbor, Tilting Saw Bench

These important features responsible for "Oliver" Leadership are prominent factors in the progress and development of the woodworking departments in school shops—a development with which "Oliver" has been closely identified from the very beginning of Industrial Arts and Vocational Education. Years of satisfactory service in the woodworking industry preceding school shop acceptance and use has given "Oliver" a background of experience in providing the school shop requirements. The illustrations on this page are typical of the complete line of woodworking machinery now available for school shops.

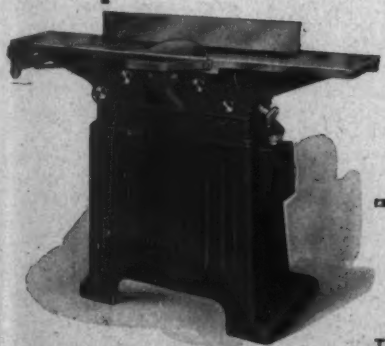
Special attention is given to School Shop Executives and inquiries and correspondence relative to requirements are solicited.

24-inch Surface Planer

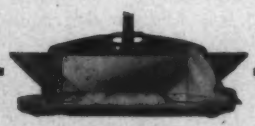
30-inch Band Saw



12-inch Speed Lathe



8-inch Hand Planer and Jointer



Wood Trimmer

Tilting Arbor Variety Saw Bench

The acceptance of the "Oliver" line by schoolmen is based upon satisfactory results from "Oliver" equipment in use in school shops throughout the country.

OLIVER

OLIVER

OLIVER MACHINERY COMPANY

Grand Rapids 2, Mich., U. S. A.

(Continued from page 56A)

more than one scene in the frame at the same time.

Voice Over. Any sound where the words are not synchronized with the lip movements of the actors in the film.

Voice Sync. Any sound where the words are synchronized with lip movements of the actors.

Wipe. The place in a film where one scene moves out of the frame and another moves into it.

AIRCRAFT SHEET-METAL WORK

ISADORE M. FENN

Chicago Vocational School

Chicago, Ill.

(Continued from page 39A of the December, 1945, issue)

Q. 106. *How are all regular square, or rectangular shapes formed?*

Ans. Either on the brake or over a suitable stake. Where wiring is required for stiffening the edge, it is done after forming.

Q. 107. *What is a transition piece?*

Ans. An irregular piece used in sheet-metal work to change from one form to another. Irregular pieces may be formed either on the brake or over a stake.

Q. 108. *Upon what principles is sheet-metal pattern drafting founded?*

Ans. Principles of geometry, which relate to the surface of solids, and may be described as the development of surfaces.

Q. 109. *What are the different methods for the development of these forms?*

Ans. (1) Parallel line development; (2) Radial line development; (3) Triangulation.

Q. 110. *When is parallel line development used?*

Ans. This method is used in developing the pattern for any form in which the opposite lines are parallel, such as elbows, tee joints, etc.

Q. 111. *When is radial line development used?*

Ans. This method is used in the layout of conical or pyramidal forms having circles or regular polygons for their bases. Figures with unequal sides that can be described within a circle in which lines drawn from the corners terminate in an apex over the method.

Q. 112. *When is triangulation method used?*

Ans. There are a number of irregular forms required in sheet-metal work the patterns for which cannot be developed by the regular methods employed in the previous developments. These irregular shapes are so formed that although straight lines can be drawn upon them, the lines would not run parallel to one another nor would they all converge at a common center. Cases of this kind are laid out by triangulation.

Q. 113. *Is sheet aluminum adaptable for use in aircraft construction?*

Ans. Yes. It is approximately 99 per cent pure and is practically unaffected by exposure to air. It is very valuable in the fabrication of nonstructural units such as fuel and oil tanks, cowling, fairing, seats, etc. A thin oxide coating is always present on the surface of aluminum and acts as a protective coating for the metal.

Q. 114. *In what two standard grades of temper is aluminum sheet obtainable?*

Ans. Half hard and dead soft (fully annealed). Half hard aluminum is used wherever possible while dead soft sheet is generally selected for severe forming operations.

Q. 115. *How is annealing of aluminum sheet accomplished?*

Ans. By heating the metal to between 650 and 925 deg. F. and holding it at this temperature from 2 to 5 hours. Aluminum sheet is obtainable in two standard grades of temper — half hard and dead soft (fully annealed).

Q. 116. *What are the properties of aluminum?*

Ans. (1) The hardness is increased by working with a proportional decrease in ductility; (2) The thermal conductivity is very high, being exceeded only by copper; (3) The weight is approximately 35 per cent that of steel; (4) The tensile strength ranges from 12,000 to 16,000 pounds per square inch; (5) It is extremely ductile and may be drawn into wire 1/250 in. in diameter; (6) It is very malleable and may be rolled into sheets 17/10000 in. in thickness; (7) It is nonmagnetic and makes a good conductor of electricity; (8) The melting point is approximately 1,225° F. and it expands about 5 per cent in fusion; (9) It is not affected by the organic acids, resists cold sulfuric and nitric acids, but dissolves in hydrochloric acid; (10) It readily decomposes in alkalies.

Q. 117. *What is done to increase the strength in aluminum?*

Ans. Aluminum is alloyed with various other metals to form the so-called strong alloys for structural use in aircraft.

Q. 118. *What is the system of symbols that has been standardized to designate the various wrought alloys?*

Ans. A figure is used to indicate the composition of the material and is directly followed by the letter "S," denoting the fact that the material is in the wrought form. Any of the following symbols denoting the temper may then be appended: (1) O = dead soft or fully annealed; (2) H = fully cold-worked or hard wrought; (3) W = heat treated, then aged at room temperature; (4) T = heat treated for maximum temper; (5) A, B, or C preceding the figure indicates a modification of the alloy.

Q. 119. *Why are aluminum alloys often treated to prevent deterioration when exposed to the atmosphere?*

Ans. Aluminum alloys do not possess the corrosion resistance found in the pure metal.

Q. 120. *What are the two methods generally used to prevent deterioration in aluminum alloys?*

Ans. (1) Anodizing — this treatment oxidizes the aluminum alloy and is accomplished by positively charging the material while submerged in a 9.25 per cent aqueous solution of chromic acid. After this treatment, the parts must be thoroughly washed in clean, warm water; (2) Alclad — this treatment plates a coat of commercially pure aluminum over an alloy making it equal to the pure metal in corrosion resistance.

Q. 121. *How is aluminum alloy stock identified?*

Ans. Most aluminum base sheets are marked with the specification number on approximately every square foot of material. If this identification is not present it is possible to separate the heat treatable alloys from the nonheat treatable alloys by immersing a sample of the material in a ten per cent solution of caustic soda (sodium hydroxide). The heat treatable alloys will turn black due to the copper content whereas the others will remain bright. In the case of Alclad the surface will remain bright, but there will be a dark area in the center when viewed from the edge of a cut.

Q. 122. *Is the identification of aluminum alloy bars, tubes, and wire impracticable?*

Ans. Yes. A code marking, consisting of painted stripes, has been established. This is also used for sheets that do not have the specification numbers stamped on the surface. Three stripes, one in the middle and one near each end, are painted around each bar, tube, etc., and across one face of each sheet that is not otherwise identified. Each stripe should be approximately 2 inches wide.

(To be continued)

COKE YIELDS PRECIOUS CHEMICALS

The following is taken from "Steel Facts," published by American Iron and Steel Institute.

Mothballs, sulfa drugs, and automobile tires are only three of a long list of household and industrial goods made wholly or in part from chemicals produced in steel plants during the process of producing coke to feed the giant blast furnaces which turn iron ore into metallic iron.

During 1944, for example, coal chemical plants of steel companies yielded an estimated 551,000 tons of ammonium sulfate, an important source of nitrogen for commercial fertilizers.

Vast Amount of Benzol Made

Also produced by steel companies in 1944 were 127,000,000 gallons of benzol, 3,900,000 gallons of naphtha and 40,000 tons of naphthalene, and such other chemicals as pyridene, phenol and toluol.

In addition to chemicals, huge quantities of tar and gas were produced.

Benzol in various grades is used to produce varnishes, wood stains and enamels; waterproofing materials and solvents. In chemically pure form it is a base for such drugs as hydroquinon and acetanilid, yields dyestuffs like aniline and indigo and goes into the preparation of DDT.

Naphtha becomes a solvent in making rubber goods, and also is an important dry cleaning agent. Naphthalene is the chief ingredient in mothballs and also goes into insecticides and dyes.

Pyridine yields sulfa drugs, vitamins and water repellents, while phenol goes into plastics and aspirin. Toluol goes into TNT, automobile tires, varnish removers, synthetic rubber and aviation gasoline.

Styrene, a colorless liquid with a peculiar, gassy odor, is another byproduct of the coke ovens. In synthetic rubber approximately one-third of the Buna S type consists of styrene, a derivative of benzene. In the manufacture of neoprene, another type of synthetic rubber, benzene also plays an important part.

In the plastics field, coal chemicals play a key part. One of the steel industry's chemicals—phenol—is basic in the manufacture of resins which can be molded into so many useful items. Naphthalene, derivatives and other chemicals in which coal products are constituents likewise are used in the plastics industry. Among other products whose family tree has its root in steel plants are synthetic flavors like vanilin, drug products such as atabrine and saccharine; nylon, shoe polishes, and some perfumes.

This speedy outboard runabout is an ideal classroom project!

It's easy to build with Exterior type DOUGLAS FIR PLYWOOD!

EXT.-D.F.P.A.
TRADE MARK REG. U. S. PAT. OFF.

Remember! Only Exterior type Douglas fir plywood should be used for boat building. Exterior type is made with completely waterproof synthetic resin binder, especially for marine use — for permanent outdoor use, too. Every panel carries the "grade trademark" shown above.

Exterior type has been used for years in marine craft of all kinds—in fish boats, sailboats, rowboats, skiffs. . .in PT boats, landing barges, ponton bridges. Standard panels, in a variety of thicknesses, are 4 x 8 feet. Longer and wider sizes can be had on special order.

- Students are bound to enjoy building a sturdy 13½ foot outboard runabout like this. It's the kind of project that will give them a real incentive—and it's designed to be built of Exterior type Douglas fir plywood, the material which makes the job easier for the most inexperienced beginner.
- Plywood is ideal for all kinds of classroom work. It's easy to work either by hand or with power tools. It bends without breaking, can't be split or punctured, holds nails and screws right at the edge. It's strong and durable, yet light in weight. Its large panel size reduces gluing-up and joining.
- Plan to use more of this modern "miracle wood."
- For additional information and technical data, write the Douglas Fir Plywood Association. For prices and delivery information, see your lumber dealer.

Douglas Fir Plywood Association
Tacoma 2, Washington

Woodworking Equipment, Tools, and Supplies

These maximum lists may be found helpful in checking inventories or preparing budgets.

If possible, each shop should have access to a projector, so that stills, silent movies, or sound movies, may be used also in the student's industrial arts and vocational education courses.

BENCH
- *a*) Shop, with hardwood tops, 1¾ in. or over in thickness, the top to project far enough to allow a rapid-acting or continuous-screw vise to be attached.
  It may be well to order a 1-in. birch or maple board wide enough to cover the working face of the bench at the time of buying the benches. This board can then be fastened to the top proper with screws and may be conveniently replaced when worn. The benches should be made of thoroughly kiln-dried lumber throughout. They may be either plain or of 6-drawer type
- *b*) Glue
- *c*) Stain, with metal-covered top
- *d*) Teacher's demonstration

BLACKBOARD — permanent or portable
BOOKCASE
BULLETIN BOARD
CABINETS — wood or metal for filing class records, instruction sheets, drawings, finishing materials, hardware, small tools, supplies, etc.
CHAIRS — teacher's and tablet arm
CORE OVEN — for patternmaking class
DESK — teacher's, with drawer compartments
FURNACE — for melting soft metals (for patternmaking class)
GLUEPOT — 1 qt. or 2 qt., electric, gas, or steam heat
GLUE WARMER OR COOKER — 1- to 5-gal. capacity
GRINDER
- *a*) Automatic knife, direct-motor-type. Size to suit largest knife used in school shop, complete with water pump, grinding wheel, and automatic stops
- *b*) Bench, hand or power
- *c*) Bench, motor-in-head. Motor bearings to be completely housed, wheels to be equipped with safety flanges and carefully guarded throughout. One fine-grit, and one coarse-grit wheel
- *d*) Revolving oilstone, pedestal type, with one fine and one coarse oilstone

JOINTER
- *a*) 6-in. or 8-in. portable jointer. Table to be fitted for rabbetting. Safety-cylinder type, equipped with safety guard
- *b*) 12, 16, or 18 in. direct motor drive, ball bearing. Cylinder to be of safety-head type. Table to be fitted for rabbetting. Jointer to be equipped with safety guard

LATHES
- *a*) 6-in. to 16-in. motor-in-head, motor-in-base, or belt-driven speed lathe, to take 24, 36, 48, 60, or 72 in. between centers. Each to be complete with cup center, spur center, faceplate, rosette chuck, tool rests, and center drift for head block
- *b*) Patternmakers', with end faceplate provision. Lathe to be of direct-motor-drive type, equipped with variable-speed motor, faceplates and floor stand. (For patternmaking class)

MORTISER
- *a*) Direct-motor-drive, or belt-driven, hollow-chisel mortiser, foot feed. Table to be of the tilting type with hold-down clamps and stop rod
- *b*) Portable, vertical, hollow-chisel mortiser, bench type

PLANER — 12, 18, 20, 24, or 30-in., motor or belt-driven, single-surface planer. Safety-head cylinder, three-knife type, fitted with good-grade steel knives. Knife-setting and jointing device complete with bar should be mounted on machine if possible

SANDER
- *a*) Belt, direct motor drive
- *b*) Disk, motor or belt driven
- *c*) Oscillating spindle, motor driven
- *d*) Portable, hand-plane type, direct motor drive
- *e*) Vertical spindle and disk sander

SAWS
- *a*) Band saw, 20 to 36 in., motor drive. Upper and lower wheels to be completely guarded. Table to tilt to 45 deg.
- *b*) Combination, band saw, crosscut saw, ripsaw, and mortiser. Machine to be completely guarded
- *c*) Cutoff, pedestal or swing type to be fitted with 12-in. to 16-in. saw
- *d*) Filing machine, direct motor drive
- *e*) Jig, direct motor or belt driven
- *f*) Portable band saw, 14 to 20 in. ball bearing, motor driven
- *g*) Saw bench, directly connected to motor, and to have both rip and crosscut saws. Rip and crosscut gauges also to be provided
- *h*) Universal saw bench, 14 to 16 in., motor driven
- *j*) Variety saw bench, motor driven, tilting table, with universal sliding table. The arbor is to be fitted for a dado head, and the table is to be slotted accordingly. The saw is to be equipped with ripping fence and miter cutoff gauges

SHAPER
- *a*) Motor drive, single or double spindle. Table to be equipped with removable center plate
- *b*) Portable shaper or router with a suitable selection of cutters

TENONER — single end, with coping heads and cutoff saw
VISES — rapid-acting or solid-nut type woodworking-bench vises, 7 to 10 in.
WOOD TRIMMERS — complete with all gauges and taper pins. Base of trimmer to be slotted and laid out for degree settings (for patternmaking class)

Woodworking—Small Tools

AWLS — brad, assorted sizes
BEVELS
- *a*) Protractor
- *b*) Sliding T, 8 in.

BITS
- *a*) Auger, 3/16 in. to 1 in. inclusive, by 16ths
- *b*) Auger, 3/16 in. to ½ in. inclusive, by 16ths
- *c*) Braces, ratchet type, 8-, 10-, 12-, or 14-in. sweep
- *d*) Countersink, for wood, rose pattern, ½ in. and ⅝ in.
- *e*) Dowel, square shank, ¼ in., 5/16 in., ⅜ in., ½ in., ¾ in.
- *f*) Expansive, ⅞ in. to 1½ in.
- *g*) Expansive, ⅞ in. to 3 in.
- *h*) Forstner, square shank, ¼ in. to ½ in. inclusive, by 16ths
- *j*) Screw driver, square shank, ¼ in., 5/16 in., ⅜ in.
- *k*) Twist drill for wood, square shank, 1/16 in. to ⅜ in. inclusive, by 16ths
- *l*) Twist drill, straight shank, 1/16 in. to ¾ in., inclusive, by 32nds

BLOWTORCH
BROOMS
BRUSHES
- *a*) Bench duster, 10 in.
- *b*) Floor
- *c*) Glue, round, 1½ in. and ¾ in.
- *d*) Glue, round, 1½ in.
- *e*) Marking, camel's hair, No. 1 and No. 2
- *f*) Varnish, flowing, 2 in. and 2½ in.
- *g*) Varnish, flat, ½ in., ¾ in., and 1 in.

BURNISHERS — oval or round
CAN OPENER
CARVING TOOLS
- *a*) Sets containing 6 tools
- *b*) Sets containing 12 tools

CHISELS
- *a*) Cold, machinists', ⅜ in. and ½ in.
- *b*) Mortising chisel and bits, ¼ in. to ⅝ in. by 16ths
- *c*) Socket firmer, bevel edge, ⅛ in., ¼ in., ½ in., ¾ in., 1 in., and 1½ in.

(Continued on page 70A)

(Continued from page 64A)

(to the nearest minute) for tangents, cotangents, sines, cosines, secants and cosecants, and logarithms have been made a part of the book.

Women's Opportunities and Responsibilities in Citizenship

Paper cover, 22 pp., 5½ by 8½ in. pamphlet. Prepared by The Committee of Consultants on Citizenship in the Home.

Gainfully Employed Women and the Home

Paper cover, 15 pp., 5½ by 8½ in. pamphlet. Prepared by The Committee of Consultants on Gainfully Employed Women and the Home.

The booklets are issued from the Office of The Woman's Foundation, 10 East Fortieth St., New York 16, N. Y. Copies may be obtained on request.

Public Affairs Pamphlets

Published by the Public Affairs Committee, Inc., 30 Rockefeller Plaza, New York, 20, N. Y.

Paper, 32 pp., 5⅜ by 8⅜ in. Price, 10 cents each, or 12 for $1.

Pamphlet No. 109 is entitled "Gyps and Swindles," and is a warning to veterans and others to beware of swindlers. The booklet is based on material assembled by various "Better Business Bureaus" and other sources.

Pamphlet No. 112 is entitled "We Can Have Better Schools." It is based on the discussions at a round table of educators held February 22, 1945.

Occupational Briefs

Published by Science Research Associates, 228 S. Wabash Ave., Chicago 4, Ill. Each brief contains 4 pp., 8½ by 10¾ in. Price, 15 cents each, or $5 per year (50 issues).

These briefs give interesting descriptions of occupations and trades. The information is quite comprehensive and each brief contains a list of references to other material on the subject.

The following briefs have been added to the list in the past months:

No. 106, Politicians; No. 107, Consumer Cooperative Workers; No. 108, County Extension Workers; No. 109, Painters (house); No. 110, Bookbinders; No. 123, Warehousemen; No. 124, Frozen Foods Workers; No. 125, Oil and Gas Well Workers; No. 126, Petroleum Refinery Workers; No. 127, Police; No. 128, Messengers and Porters.

A Vocational Guide for Women

By L. Cornelius Longarzo. Cloth, 119 pp., 6⅞ by 10⅝ in. Published by Catholic Youth Organization of the Archdiocese of New York, Inc., 35 East 51st St., New York City.

A book for those who are interested in guiding young girls into proper vocational pursuits. It contains an enormous number of classified references on occupations, selected vocational periodical references, vocational literature, occupational biography, occupational fiction, and counseling, aptitude tests, and occupational rating scales. It also gives references to reading matter on job hunting techniques, state and federal labor legislation, job leads, placement of the handicapped, and an index to classified titles of industries and occupations.

(Continued on page 82A)

MORE THAN FIFTY YEARS OF ENGINEERING "KNOW HOW"

BACK UP YOUR GOOD JUDGMENT

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CRESCENT

on your requisition for

Woodworking Machinery

Standing behind your choice of Crescent is the experienced craftsmanship of a company that, for more than fifty years, has specialized in building precision woodworking machinery exclusively.

With Crescent equipment, you provide students with real production training — on machines well-known in industry for high performance standards.

Crescent machines have the stamina to withstand rough usage by beginners. They are easy to understand, so pupils quickly learn to operate them properly — and with safety. They provide economy of power, space, and maintenance.

Select shop equipment that helps accustom your students to accurate, creditable work. Specify *Crescent* on your requisition for woodworking machinery.

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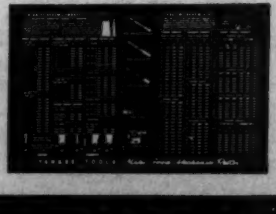
"YANKEE" TOOLS
THE ANSWER
TO SMART TEACHING
No. 2101 "YANKEE" RATCHET BRACE
No. 2150 "YANKEE" BIT EXTENSION
No. 41 "YANKEE" AUTOMATIC DRILL
No. 30A "YANKEE" SPIRAL RATCHET SCREW DRIVER
No. 10 "YANKEE" RATCHET SCREW DRIVER
No. 15 "YANKEE" RATCHET SCREW DRIVER
No. 1545 "YANKEE" RATCHET HAND DRILL
No. 1913 "YANKEE" VISE
No. 880 "YANKEE" VISE

Good mechanics may be born, not made. But better mechanics are *made* by "Yankee" Fine Mechanics' Tools, the choice of discriminating users everywhere, for more than half a century. And why are "Yankee" Tools their choice? Because they have been *designed* to save time, money, and trouble on their jobs . . . and because they are *built* to give long, hard, dependable service. There's a better-mouse-trap ingenuity about "Yankee" Tools that makes them teacher's pet. Right now, Demand has made a Casualty of supply. But you will one day again be training youth and inexperience with the tools that age and experience demand.

FREE! Write for a copy of the handy "Yankee" Reference Chart, featuring relative tables of screw-driver blade and screw sizes, and giving graphic instructions on how to drive screws correctly.



"YANKEE" TOOLS
make good mechanics better
North Bros. Mfg. Co., Phila. 33, U. S. A.
Established 1880

(Continued from page 68A)

- *d*) Socket firmer, plain edge, ½ in., ¾ in., and 1 in.
- *e*) Tanged firmer, bevel edge, ⅛, ¼, ½, ¾, 1, and 1¼ in.

CLAMPS
- *a*) Bar, 24, 36, 48, and 60 in.
- *b*) Hand-screw, 4, 5, 6, 7, 8, 10, 12, and 14 in.
- *c*) Malleable-iron C, 4, 6, and 8 in.

DIVIDERS — wing, 6 in. and 10 in.
DOWEL PLATE — 6 in. long
DOWELING JIGS — with bushings
DRAWKNIVES — 7 in.
DRILL
- *a*) Automatic hand, with 8 drill points
- *b*) Chuck, 0 to ⅜ in.
- *c*) Hand, 0 to ⅜ in., for round-shank drills
- *d*) Star, for concrete, ½ in. and ¾ in.

FILES
- *a*) Auger bit, assorted, 6 in.
- *b*) Cabinet, 8 in. and 10 in.
- *c*) Card and brush
- *d*) Flat, wood, 10 in.
- *e*) Mill, bastard cut, 12 in.
- *f*) Round, bastard cut, 12 in.
- *g*) Taper, slim, 5½ in. and 7 in.

FIRST-AID CABINET AND SUPPLIES
GAUGES
- *a*) Bit, adjustable
- *b*) Jointer
- *c*) Marking, metal or hardwood
- *d*) Mortise, metal or hardwood
- *e*) Panel

GLASS CUTTER
GOUGES
- *a*) Tanged firmer, outside ground, handled, ⅛, ¼, ½, ¾, and 1 in.
- *b*) Tanged firmer, inside ground, handled, ⅛, ¼, ½, ¾, and 1 in.
- *c*) Spoon, ½, ¾, and 1 in.

HAMMERS — claw, bell faced, 10, 12, 13, and 16-oz.
HATCHET — bench, 4-in. cut
JARS — earthenware, 1-qt. capacity
KNIVES
- *a*) Jointer, to fit power machine
- *b*) Planer, to fit power machine
- *c*) Sloyd, 3-in. blade

LEVELS
- *a*) Wood, 24 in.
- *b*) Machinists', 12 in.

MALLETS — hickory, 3 by 5 in. head
NAIL SETS — 1/16 in. and 3/32 in. points
OILERS — bench, 1/3 pt., coppered, best grade
OILSTONES
- *a*) 1 by 2 by 8 in. in iron box
- *b*) Gouge slip, medium, 4½ by 2⅛ by ⅝ by 5/16 in.
- *c*) Gouge slip, fine, 3 by 2 by ⅜ by ⅛ in.

PINCERS — 6 in. carpenters'
PINCH DOGS — ¾, 1, and 1¼ in.
PLANES
- *a*) Block, adjustable, 6 in. long, 1⅝-in. cutter
- *b*) Circular
- *c*) Combination, adjustable
- *d*) Core box
- *e*) Duplex, fillister and rabbet
- *f*) Fore, ⅛ in., 2⅜-in. cutter
- *g*) Irons, double
- *h*) Jack, 14 in., 2-in. cutter
- *j*) Jointer, 24 in.
- *k*) Round, wood, 1¾ in.
- *l*) Router
- *m*) Smooth, 9 in., 1¾ in. or 2-in. cutter

PLIERS
- *a*) Roundnose, 5 in.
- *b*) Side-cutting, 6 in.

PUTTY KNIVES
RASPS — half round, wood, 10 in.
RULES
- *a*) Board
- *b*) 1 ft. or 2 ft. graduated by 8ths and 16ths
- *c*) Shrink, ⅛ in., 3/16 in.

SAWS
- *a*) Back, 12 in., 14 point
- *b*) Band, to fit power machine
- *c*) Compass, 10 in.
- *d*) Coping, frames
- *e*) Coping, blades
- *f*) Crosscut, 9 tooth, 22 in. long
- *g*) Crosscut, circular for power machine
- *h*) Dado, ⅛ in. to 1 1/16 in. to fit power-saw arbor
- *j*) Hack, frames, 10 in. or adjustable
- *k*) Hack, blades, 10 in.
- *l*) Keyhole, 10 in., 10 point
- *m*) Rip, 7 point, 22 in. long
- *n*) Rip, circular for power machine
- *o*) Set, 10 points per inch and finer
- *p*) Set, 10 points per inch and coarser
- *q*) Turning frame, 14 in.
- *r*) Turning blades, 3/16 by 12 in., 10 tooth
- *s*) Miter box, 24 by 4 in. saw, 7-in. capacity at miter

SCRAPERS
- *a*) Cabinet
- *b*) Glue, triangular
- *c*) Veneer, blade, 2¾ in. long, handle 11 in. long

SCREW DRIVERS
- *a*) Cabinetmakers', 4, 6, and 8 in.
- *b*) Quick return, spiral ratchet

SHOOT BOARD — and plane
SNIPS — tinners', forged steel, 2½-in. cut
SPOKESHAVES — adjustable, raised handle, 10 in. long
SQUARES
- *a*) Combination, 12 in.
- *b*) Try-, iron handle, 8 in.
- *c*) Framing, 2 ft.

STEEL FIGURES — hand cut, ⅛ in.
TAPELINE — 50 ft., steel
TRAMMEL POINTS — adjustable metal frame, steel points
TURNING TOOLS
- *a*) Calipers, 6 in. inside and outside
- *b*) Calipers, 12 in. inside and outside
- *c*) Parting tools, ⅜ in.
- *d*) Round point, ¼ in., ½ in., ¾ in.
- *e*) Spear point, ¼ in., ½ in., ¾ in.
- *f*) Square point, ¼ in., ½ in., ¾ in.
- *g*) Turning chisels, ¼ in., ½ in., ¾ in.
- *h*) Turning gouges, ¼ in., ½ in., ¾ in.
- *j*) Turning skews, L.H., ¼ in., ½ in., ¾ in.
- *k*) Turning skews, R.H., ¼ in., ½ in.

VISE — 3-in. jaw, anvil face
WRENCHES
- *a*) Adjustable, 8, 10, and 12 in.
- *b*) Headless setscrew
- *c*) Pipe, 10 in. and 12 in.
- *d*) S type or open-end type to fit ⅛-in. to 1-in. N.C. nuts

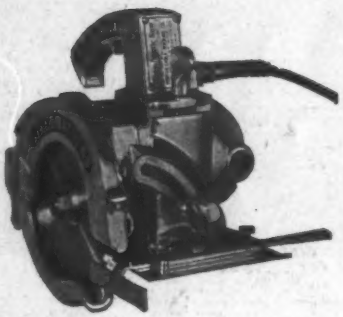
(Continued on page 72A)

Industry requires of Your students---

A Workable Knowledge of Industry's Own Tools!

PORTER-CABLE

More and more, industry requires of job applicants a workable knowledge of its own tools. Thus a considerable part of the apprentice period is spent in the classroom. The knowledge must be a broad working base — a base upon which a specialized skill can be quickly built. For that job you cannot choose more wisely than PORTER-CABLE tools! Wide in their adaptability, these machines teach BOTH — general acquaintance with machines, and specific skills in their operation! Your choice of training tools affects your students' future. Choose wisely . . . choose PORTER-CABLE!



G-8 WET-DRY BELT SURFACER

Wartime production schedules have demanded the introduction of this equipment in any factory with a surfacing problem. You can't prepare a student better, than on this universally accepted machine. It's vital to the fast-growing plastics industry!

Speedmatic SAWS

This is the tool that has enabled the building industry to keep abreast of technological advances elsewhere!

G-4 BELT SURFACER

For versatility, and introduction to production technique, here's industry's all-around tool. For surfacing and fast finishing of small parts!

TAKE-ABOUT

THE DUSTLESS SANDER

From the home workshop to the greatest factory — this light, dependable sander is speeding up work requiring the finest finish!

Speedmatic FLOOR SANDER

Floor finishing, through the use of this machine, has become faster, better, and easier. It's in use wherever floors are finished!

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Please send me without obligation descriptive matter on Porter-Cable machines indicated below.

☐ Wet-Dry Belt Surfacers ☐ Speedmatic Floor Sanders
☐ Take-About Sander ☐ Speedmatic Saws

Firm .....
Individual ..... Position .....
Address .....

FOLEY *Automatic* SAW FILER

The ONE MACHINE THAT FILES AND JOINTS HAND, BAND AND CIRCULAR SAWS

Nothing is more important to the success of your training program than your saws. Students dull them fast — they need sharpening often.

With a Foley Automatic Saw Filer you can sharpen your saws more perfectly than is possible by hand. You can do it quicker, — and your saws will stay sharp longer. Your students will turn out better work with sharp saws. ALSO by keeping your saws sharp with a Foley, — you will easily double their cutting life and have less breakage, reducing replacements to a minimum.

The Foley is the only machine that files and joints all hand, back and mitre box saws from 3 to 16 points per inch, cross-cuts circular saws up to 16" diameter (24" optional), and band saws up to 24' long. Patented jointing principle automatically evens up large and small teeth, so saws cut faster, truer, cleaner — stay sharp longer.

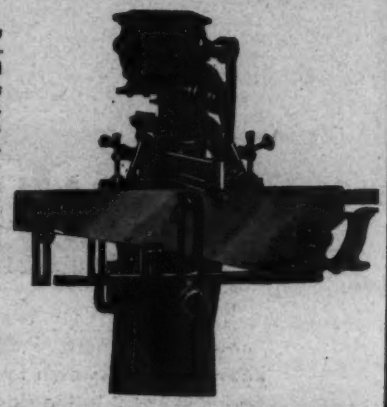
Train your students to file saws on a Foley, for they will find thousands of Foley Saw Filers used in industry, Army, Navy, Air Corps, etc. Hundreds of schools and colleges use them to save on saw filing costs and replacement expense.

TYPICAL SCHOOL USERS

Berea College, Berea, Ky.; Board of Education, Cleveland, Ohio; Boys Technical H. S., Milwaukee, Wis.; Charleroi School District, Charleroi, Pa.; Redlands Public Schools, Redlands, Calif.; Stout Institute, Menomonie, Wis.

30-DAY TRIAL OFFER

You may have the privilege of using a Foley Saw Filer in your own shop for 30 days, — and see for yourself its training advantages and operating economies. Send coupon for details.



The FOLEY SAW FILER Makes...

an OLD SAW **LIKE NEW!**

FOLEY AUTOMATIC SAW FILER

FOLEY MFG. CO., 18 2nd Street N.E., Minneapolis 13, Minnesota
Please send literature on the Foley Automatic Saw Filer and details of your 30-Day Trial.

Name .....

Address .....

(Continued from page 70A)

Woodworking— Materials and Supplies

ALCOHOL

BENZINE

BRADS — ⅜ in., ½ in., and ⅝ in. No. 20; ¾ in. and ⅞ in. No. 19; 1 in. No. 18; 1¼ in. and 1½ in. No. 16; 1¾ in. No. 15; 2 in. and 2½ in. No. 14

CARBON PAPER — black

COLORS — dry: burnt sienna, burnt umber, cobalt blue, chrome yellow, drop black, lamp black, Prussian blue, raw umber, Vandyke brown, and vermilion

COLORS — ground, in oil or japan: burnt sienna, burnt umber, cobalt blue, chrome yellow, drop black, lamp black, Prussian blue, raw umber, rose lake, Vandyke brown, and vermilion

DECALCOMANIA TRANSFERS

DOWEL PINS AND PLATES

DOWELS: hardwood, 3-ft. lengths, ¼ in., 5/16 in., ⅜ in., ½ in., ¾ in.

ENAMEL
- *a*) Selected colors
- *b*) Undercoater

FILLERS — paste: natural, golden oak, dark oak, and mahogany

FILLETS — leather, ¼ in. and ½ in.

GLUE
- *a*) Casein, hide, best grade cabinet
- *b*) Liquid

HARDWARE: Brackets, buttons, butts, casters, catches, chain, chest corners, chest trimmings, corner braces, corner irons, corner plates, desk fittings, door fittings, escutcheons, fasteners, handles, hangers, hinges, hasps, holders, hooks, knobs, latches, lamp fittings, lid supports, locks, pulls, smoking-stand outfits, springs, stops, supports

HOOKS
- *a*) And eyes
- *b*) Cup
- *c*) Screw and
- *d*) Square screw

LACQUER — black, clear, cobalt blue, ivory, medium green, red, thinner, white, and yellow

LUMBER — Ash, balsa, bass, birch, cherry, cypress, locust, mahogany, maple, oak, poplar, red cedar, red gum, redwood, sap gum, yellow pine, walnut, white pine
In ordering pine, mill run, kiln dried will be found suitable for carpentry, while short, select, kiln dried, 4 in. and wider or No. 1 shop common, kiln dried will be required for cabinetmaking and patternmaking
Hardwood, for furniture, should be specified first and second grade, kiln dried, standard widths and lengths, or short lengths

MOLDINGS

NAILS
- *a*) Common, 6d, 8d, and 10d
- *b*) Flathead, ½ in. No. 20, ¾ in. No. 19, 1 in. No. 18, 1¼ in. and 1½ in. No. 16, and 2 in. No. 14
- *c*) Finishing, 4d, 6d, and 8d

OIL
- *a*) Linseed, boiled
- *b*) Linseed, raw
- *c*) Machine
- *d*) Rubbing

OVERLAY CARVINGS

PANEL OR PLYWOOD — 3 ply, 5 ply, and 7 ply

PATTERN LETTERS

PINS — escutcheon

PUMICE STONE — No. 0

RAPPING PLATES

ROTTENSTONE

SANDPAPER — Garnet cabinet paper, 3/0, 2/0, 0, ½, 1
Garnet finishing paper, 6/0, 4/0
Garnet paper can also be obtained in rolls of 50 yd. in widths 4 in. up to 48 in. Narrower widths on special order

SCREW EYES

SCREWS
- *a*) Flathead, brass, No. 3 by ⅜ in., No. 4 by ½ in., No. 5 by ⅝ in., No. 5 by ¾ in., No. 6 by ¾ in., No. 7 by ⅞ in., No. 8 by 1 in., No. 10 by 1¼ in., No. 10 by 1½ in., No. 12 by 1¼ in., No. 12 by 1¾ in., No. 10 by 2 in.
- *b*) Flathead, bright, No. 3 by ½ in., No. 4 by ½ in., No. 6 by ¾ in., No. 7 by 7⅞ in., No. 8 by 1 in., No. 10 by 1 in., No. 8 by 1¼ in., No. 10 by 1¼ in., No. 14 by 1¼ in., No. 10 by 1½ in., No. 12 by 1½ in., No. 10 by 1¾ in., No. 12 by 1¾ in., No. 10 by 2 in., No. 12 by 2 in., No. 14 by 2 in., No. 12 by 2¼ in., No 14 by 2¼ in., No. 14 by 2½ in.
- *c*) Oval head, brass, No. 5 by ¾ in., No. 6 by ¾ in., No. 7 by ⅞ in., No. 8 by 1 in., and No. 10 by 1¼ in.
- *d*) Roundhead, blued, No. 3 by ⅜ in., No. 3 by ½ in., No. 5 by ¾ in., No. 6 by ¾ in., No. 7 by ⅞ in., No. 8 by 1 in., No. 10 by 1¼ in., No. 10 by 1½ in., No. 12 by 1½ in
- *e*) Roundhead, brass, No 3 by ⅜ in., No. 4 by ½ in., No. 4 by ⅝ in., No. 5 by ¾ in.

SHELLAC
- *a*) Orange, cut 4 lb. to the gal.
- *b*) Sticks, assorted colors
- *c*) White, cut 4 lb. to the gal.

NOTE: Shellac should be kept in glass or earthenware containers

STAINS — oil, spirit or water. Fumed oak, dark oak, golden oak, light oak, mahogany, and walnut

STEEL WOOL — No. 0 and No. 2/0

TURPENTINE

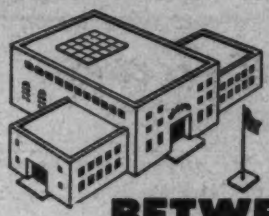
TWINE

VARNISH — coach, flat, remover, spar, and rubbing

WASTE — cotton, white

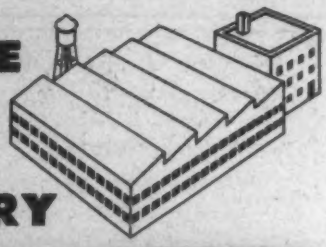
WAX — bees and finishing

WHITE LEAD



THE SHORTEST DISTANCE

BETWEEN SCHOOL AND FACTORY



IS A

Walker-Turner

TRAINING *LINE!*

Students trained on Walker-Turner Machine Tools find the transition from school to factory easy. Their daily school work has familiarized them with the very machines they'll find by the thousands in Industry. That's one of the big advantages of using these *production* machines.

By providing *faster* training, Walker-Turner Machine Tools "shorten the distance" in time, too! Simple to operate, they save tedious hours in the "breaking-in" period. Exceptional versatility, rugged construction, safe operation, low price are other important Walker-Turner features. Write today for our latest catalog.

WALKER-TURNER COMPANY • PLAINFIELD, N. J.

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MACHINE TOOLS

DRILL PRESSES — HAND AND POWER FEED • RADIAL DRILLS
METAL-CUTTING BAND SAWS • POLISHING LATHES • FLEXIBLE SHAFT MACHINES
RADIAL CUT-OFF MACHINES FOR METAL • MOTORS • BELT & DISC SURFACERS

"Thanks, thanks to thee,
my worthy friend,
For the lesson thou hast
taught!"

To the teachers of industrial and vocational arts, we re-dedicate this tribute of Longfellow's. For who better teaches so that of each pupil it might be said "A mighty man is he!" Not that one in a thousand pupils is apt to become the "village smithy," but those who do learn through you to earn with hands and dignity must feel naught but thanks.

Bellows, or sledge hammer, chasing tool or hack saw—you will find the quality of our shop supplies equal to the highest standard you may require. Why not write for our 80-page catalogue with its complete list of tools, metals, and all materials for industrial and vocational purposes.

METALS

COPPER — BRASS — NU-GOLD

ALUMINUM — IRON — STEEL

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Shop Equipment News

New Products—Publications

NUMEROUS PRECISION GAUGES ASSEMBLED FROM ONE KIT

The new gauge kit, named "Producto-Chek," was designed and is manufactured by the Gage Division of The DoAll Company, Minneapolis, Minn. It consists of a number of instruments to be used in conjunction with gauge blocks for quickly setting up practically any type of inspection gauge. A few examples of these are the dial indicating snap gauge, plain bench comparator, dual bench comparator, angle comparator, square comparator, precision height gauge, depth gauges, and a series of go-no-go snap gauges of any size up to 18 in. Plug gauges and internal gauges of any size in steps of .0001 in. can be quickly made up from the set. In addition, gauges such as hole to hole, hole to base, parallel bore gauges, pitch diameter,

Precision gauge kit

and many others can be made up for special applications. A set of holders from 2 to 18 in. in length are designed to carry the gauge blocks. Besides the hand held gauges, a whole series of bench and surface plate gauges can be assembled by using the base block, master flat, or numerous other attachments. There also is an indicating snap gauge, and an internal gauge incorporating dial indicators.

Then, there is an angle comparator using two dial indicators, which is set with a sine bar. When an angle identical to that of the sine bar setup is checked, the dials read alike. Included also in the kit is a multiple bench comparator that makes two measurements simultaneously, permitting increased speed in production checking. Another outstanding instrument of the kit is an indicating square check gauge. With this, the work is placed on a master flat and is simply pushed against a back stop, a dial indicator showing instantly whether or not the angle is 90 deg. A unique feature of the kit is a set of "wires" of various diameters. These are lapped to the accuracy of gauge blocks and are used direct as plug gauges or in caliper jaws where square jaws could not function or where combination square and round caliper jaws are needed. Although it is used in conjunction with gauge blocks and in some cases as a surface plate, the kit itself does not include these items. Any one of the countless gauges can be assembled in five minutes or less, and it takes even less time to dismantle and replace in the kit.

Despite the fact that the Producto-Chek Gage Kit will actually do the work of more than a million separate gauges with gauge block accuracy, it weighs but forty pounds and is housed in a streamlined hardwood box 10 by 20 by 4 in.

For brief reference use IAVE—1210.

RUBBER STAMP MAKING EQUIPMENT

A new rubber stamp mold press and vulcanizer has just been placed on the market by the G. A. Pratt Co., 4133 Northcote Ave., East Chicago, Ind.

Both the vulcanizer and the molding press castings are made of aluminum. The heat for the vulcanizing can be obtained from any source. Molds up to 2½ by 3½ in., can be made and the outfit is thoroughly efficient in every way.

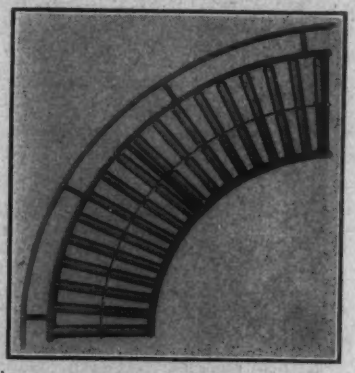
Rubber stamp equipment

It is excellent for training purposes, may be used in starting a small business, or can be utilized to satisfy a hobby interest.

For brief reference use IAVE—1211.

LYON GRAVITY ROLLER CONVEYORS

Lyon Metal Products, Inc., Aurora, Ill., is marketing a completely packaged line of gravity roller conveyors which have numerous uses for the handling and transportation of cartons, bales,



Curved section of Lyon gravity roller conveyor

packages, boxes, crates, and the like. They are obtainable in 10-ft. straight sections, and in curved sections, 12, 18, and 24 in. wide, together with trestles 18 and 24 in. wide.

With a combination of straight and curved sections a very flexible line of any length may be made.

All rollers are fitted with high-grade ball bearings, and the conveyors, regardless of width, are good for safe loads up to 200 lb.

For brief reference use IAVE—1212.

NEW HEADSTOCK FOR CINCINNATI HYDRAULIC UNIVERSAL GRINDING MACHINES

A new headstock has recently been applied to the line of hydraulic universal grinding machines built by Cincinnati Grinders Incorporated, Cincinnati 9, Ohio.

Of major interest is the adoption of a modified lathe standard spindle nose, which permits standard chucks and face plates to be mounted without intermediate adapters.

The majority of live spindle work will be accomplished with a chuck or faceplate mounted directly on the spindle nose. However, it may

(Continued on page 78A)

Millions of Students

Know the Performance and Dependability of Millers Falls Tools

In manual training shops all over the country millions of students have learned the performance and dependability of Millers Falls Tools. They have learned the meaning of the Millers Falls slogan — "One Thing in Common — Quality!"

Quality tools inspire students to do a better job. They give the best teaching results. That's why thousands of industrial arts instructors choose and depend upon Millers Falls tools — tools that combine excellence of design and advanced construction with fine workmanship.

There are Millers Falls hand and electric tools for almost every use. Ask your supplier or write to Millers Falls for complete details.

Millers Falls Company • Greenfield, Massachusetts

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Easiest-to-Teach-with

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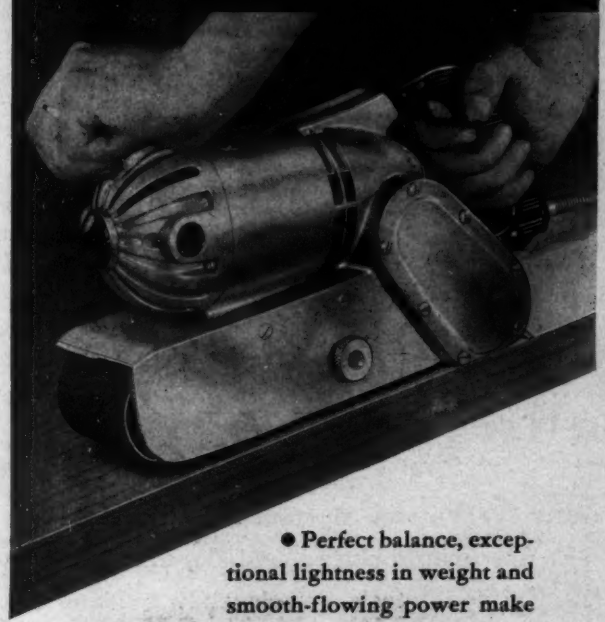

● Perfect balance, exceptional lightness in weight and smooth-flowing power make SKILSANDERS the easiest of all belt sanders to handle...easiest for students to master. Even beginners need little instruction to learn how to produce a ripple-free finish quickly on any flat surface of wood, metal or compositions. Ask your distributor to show you how you can simplify your teaching job by using SKILSANDERS in your shop.

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MADE BY SKILSAW, INC.

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METALWORK, TECH. & PRACTICE

Describes tools, materials and operations of many metalworking occupations, inlcuding machine shop, automotive, aeronautical, metal pattern making, etc. Modern Handbook for Metal Trades. 400 pps. $4. Ludwig.

ENGINE LATHE OPERATIONS

An instructional manual for beginners presenting a series of operational units. Charts and tables for the lathe operator included. Job sheets in blueprint form gives student opportunity to read technical drawings and to apply information he interprets to actual work on the lathe. $1.60. Whipple and Baudek.

MACHINE SHOP PROJECTS

A collection of 25 practical projects selected to offer training in the basic machine operations and to require a minimum of material. Related topics for study and an up-to-date list of reefrence books are included. Blueprint of each job is given. 112 pps. $1. Roy E. Knight.

AERONAUTICAL INSTRUMENT PROJECTS

This book provides simplified, practical information about the many instruments essential to successful aviation, with instructions for building these instruments to enable the student to fully understand their use and operation. A few radio and weather instruments are included. 25 projects. 124 pps. $1.20. Weber.

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WITH PROJECTS IN

How your students will enjoy working with plastics! Crystal-clear, easily carved, cut and shaped, plastics will enable them to produce finished products of true professional appearance, that will bring exclamations of admiration from friends and parents.

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Send today for catalog, sample working drawings of six projects, and full details. Address Dept. 3V.

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Manufacturers of

Circular Saws, Groovers, Band Saws

Huther Bros. Saws are the result of more than sixty years' successful and uninterrupted experience in the manufacturing of saws. Each saw embodies the highest type of workmanship and is backed by a guarantee to be as free from flaws and seams as possible. Complete catalog on request.

Dado Head

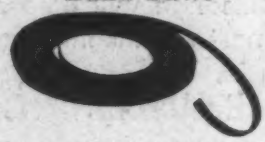
Our dado head developed from our own patents cuts grooves with or across grain, smooth, sharp sides, grooves from ⅛" up to 4" and over. Easily adjustable. Consists of 2 outside Cutters ⅛" thick and inside cutters to make desired cut. Inside cutters in 1/16", ⅛" and ¼" thicknesses. These Groovers make a perfect cut and leave the bottom smooth.

Saw Vise

Setting Stake

These are useful articles for the filing room and were both developed for use in our own filing department. Vise is easily adjusted for various bevel filing and takes saws up to 18" diameter.

Band Saws



We make both wood and metal cutting band saws, also special temper saws for fibre, bakelite and soft metals. Let us know what you cut and we can furnish a saw for the purpose.

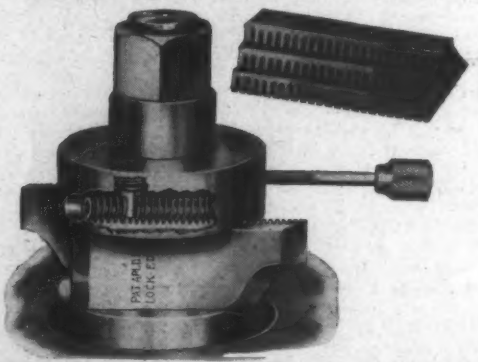
High Speed Knives

Shaper Stock, Ground Flat Stock

We manufacture thin High Speed Steel Knives, Solid Moulder Knives from High Speed Steel or Special Laid Steel. We can also furnish ground stock in various thicknesses and widths, square edges, in High Speed or best quality Tool Steel.

Safety Shaper Collar

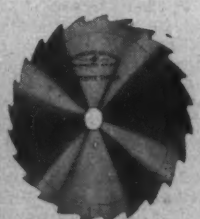
With Lock-Edge Knives and Screw Adjustment



Can be made to fit any size shaper spindle. Lock-edge knives can be furnished in bars 24" long or less.

Inserted Tooth Groover

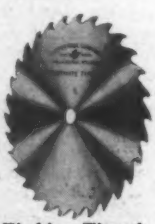
This is the perfect Groover for end grain cuts in hard wood. Teeth are High Speed Steel, front to back clearance, and require grinding on top only. Cuts full width groove through life of teeth. Teeth can be replaced.



Firthite Tipped Inserted Type

Firthite Tipped Saws

We manufacture Firthite Tipped Saws to cut Plywood, Plastics, Tempered Masonite, Teakwood, etc. They are especially desirable for use on Straight Line Rip Saw Machines.



Firthite Tipped Solid Type

The most important teaching aid yet devised...

TEACHING WITH FILMS

With Special Applications to Industrial Arts and Vocational Education

By George H. Fern: Vice President, Industrial Education, American Vocational Association; formerly Director, Michigan State Board of Control for Vocational Education, and Eldon B. Robbins: Supervisor, Audio-Visual Aids, Michigan State Board of Control for Vocational Education.

Now—in one volume—all the practical information relative to the effective use of teaching films, with special application to the needs of shop teachers.

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THE BRUCE PUBLISHING COMPANY, 703 Montgomery Bldg., Milwaukee 1, Wis.

(Continued from page 74A)

be desirable to remove the work and chuck as a unit for inspection. An operation of this type may be accomplished with the "quick change" adapter applied to the chuck.

Mounting the spindle so that it runs on two precision adjustable antifriction bearings, one at the front and one at the rear end, with a single accessible adjustment at the rear, is an added improvement. This results in more rigid construction, with very little overhang from the front bearing to the spindle nose.

Additional information, including a dimensional sketch of the spindle nose, may be obtained by writing to Cincinnati Grinders, Inc., Cincinnati 9, Ohio. Ask for catalog G-486-3 for data on their 12-in. hydraulic universal grinder or G-474-2 for data on their 14-in., 16-in., and 18-in. hydraulic universal grinders.

For brief reference use IAVE—1213.

NEW WEIDENHOFF CATALOG

The new 26-page Weidenhoff catalog pictures the large variety of battery and electrical service tools which this firm is now producing for civilian use.

Among the items described are the model 963 mica undercutter and armature stand; several models of electronic tachometers; engine and gas analyzers; condenser, resistance, coil and ignition testers; the model 1057 Distrib-U-Scope; generator test benches; magneto test fixtures; magnetizers; magneto superchargers; and battery chargers of various kinds.

For brief reference use IAVE—1214.

NEW A.C. ARC-WELDING MACHINE BOOKLET

New and improved Wilson "Bumblebee" alternating current transformer arc-welding machines are described fully in a 16-page illustrated booklet just published by Air Reduction, New York City.

Among the machines described are the 300 and 500-amp. standard and all-weather models, and the new 200-amp. "Bumblebee," which has been designed to meet the demands for a small arc welder comparable in performance with the big "Bumblebees."

Engineering data and complete specifications are supplied. Precise labeled drawings and numerous photographs supplement the text.

Copies of the booklet are available upon request to Air Reduction, 60 East 42nd St., New York 17, N. Y.

For brief reference use IAVE—1215.

CATALOG OF LABORATORY PANELS AND ASSOCIATED EQUIPMENT

An interesting catalog explaining and illustrating a variety of pieces of equipment for use in the physics, chemistry, and electrical laboratories of junior, senior, technical high, and full-time and part-time vocational schools, and colleges and universities, has just been published by the Standard Electric Time Co., Springfield 2, Mass.

The catalog also shows layouts of the equipment in the various types of institutions of learning.

For brief reference use IAVE—1216.

PERECO EQUIPMENT CATALOG

A catalog explaining fully the Pereco electric furnaces, kilns, and heat-treating equipment manufactured by the Pereny Equipment Co., Columbus 3, Ohio, has just been published.

In it are illustrated and described all the various models of high and low temperature furnaces for ceramic uses, industrial ovens, dip tanks, potter's wheels, ball mills, whirlers, and the like made by this firm.

For brief reference use IAVE—1217.

SCHOOL PRINTING PROJECT FOLDERS

A "Share Your Ideas" folder which will eventually form a printing project "Idea File" for educational institutions has just been started by the American Type Founders, Department of Education, 200 Elmora Ave., Elizabeth B, N. J.

The first of this series is now available.

Teachers of printing are invited to submit suitable samples of school printing for inclusion in future project folders.

Be sure to get No. 1 of the series for your file.

For brief reference use IAVE—1218.

PLANS POSTWAR EXPANSION

The Sterling Tool Products Company, 363 East Ohio St., Chicago, Ill., has acquired an additional 19,000 sq. ft. of floor space to permit an enlarged production schedule for the postwar period.

This firm manufactures the Sterling 1000 Portable Electric Sanding Machine, and the Sterling Speed-Bloc Air-Driven Portable Sanding Machine.

For brief reference use IAVE—1219.

ARC WELDING ACCESSORIES CATALOG

An up-to-date price list and catalog of Airco arc welding accessories has just been published by Air Reduction. This 12-page booklet illustrates and describes a complete line of accessories for all types of arc welding machines and operations.

Types of equipment covered include: electrode holders, graphite electrodes, welding cable, cable connectors, and cable lugs. Also listed are: welding helmets, goggles, face shields, headgear, aprons, gloves, and sleeves.

An additional section is devoted to Airco Heliwelding equipment which was developed in response to pressing demands for a better method of welding magnesium.

Copies of this booklet may be obtained by writing for catalog No. 130 to Air Reduction, 60 East 42nd St., New York 17, N. Y., or to the nearest Airco office.

For brief reference use IAVE—1220.

NEW WELDING SOCIETY AWARD

To stimulate undergraduate interest in welding, funds have been donated by A. F. Davis, of the Lincoln Electric Company, for the A. F. Davis Undergraduate Welding Award, which will consist of four cash prizes totaling $700 to be presented annually to authors and publications for the best and second best articles on welding published in undergraduate magazines or papers during the preceding year. Any undergraduate of a college, university, or institute of technology in the United States or Canada is eligible, but the paper must be published in an undergraduate publication. Judges selected by the Educational Committee of the American Welding Society will select the winning paper in July of each year on the basis of originality of the paper and thoroughness in

(Continued on page 82A)

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NEW YORK: 106-110 Lafayette Street

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PRECISION TOOLS:

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- Steel Scales
- Indicators
- Protractors
- Bevels
- V Blocks
- Clamps
- Hold Downs
- Scribers
- Rules, Steel
- Punches, Center & Drive Pin

Gages:

- Center
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- Drill Grinding
- Feeler
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Tool Sets, Students

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- Surveyors Chain
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Flexible—Rigid

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RULES:

- "Red End" and Other Spring Joint
- Aluminum Folding
- Boxwood & Caliper
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- Etc., Etc.

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"MACHINE-OF-THE-MONTH"

No. 28 SHAPER

2 H.P. geared motor rotates spindle 10,000 r.p.m.

Reversing switch, Capacity for large cutters up to 2¾" wide. Vertical spindle adjustment 1½". Collet for routing bits extra.

For fast, smooth shaping work, this 10,000 r.p.m. gear-drive Shaper is without equal! Cutters and knives available for every kind of moulding and shaping operation. Adapter and collet permits use of small routing bits and cutters, adding extra versatility.

Cuts equally well with and against grain and on hard or soft wood.

Write today for detailed bulletins and prices on the Wallace No. 28 Hy-Gear Shaper. We also manufacture quality Universal Saws, Radial Arm Saws, Bandsaws, Jointers, Mortisers, Lathes, Oilstone Grinders, etc.

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An Airbrush for Every Purpose

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These modern texts have been especially prepared for school use. You can employ them to excellent advantage in your regular program as well as your veteran training work. An examination will convince you of their suitability to your classroom needs. Any books sent for 30 days ON APPROVAL inspection subject to our educational discount if retained.

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14.	Plastics (enlarged 3rd edition)	4.00
15.	Plastics Mold Engineering	7.00
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17.	How to Remodel a House	4.75
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19.	Building Trades Blueprint Reading Part 1	2.00
20.	Building Trades Blueprint Reading Part 2	2.00
21.	Machine Tool Guide	7.50

(TEAR OFF HERE AND MAIL TO US)

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Please send the following texts for 30 days ON APPROVAL examination. I will either return them at the end of that time or remit less your educational discount. Order by number — just circle numbers wanted.

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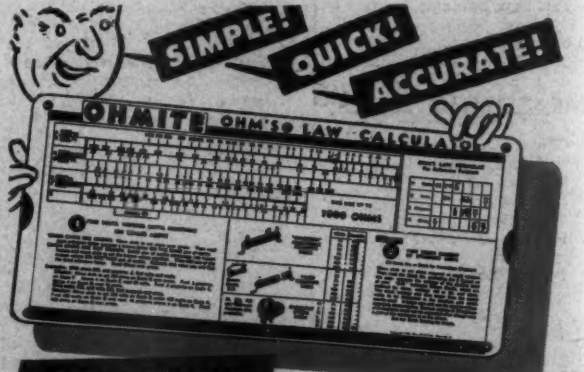
Name

School

School Address



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The Dean of the Graduate School, 234 Administration Building, will supply a Bulletin of General Announcement and a blank of "Application for Admission."

Bulletins of the Summer Session may be obtained from the Director of Summer Session, 773 Administration Building.

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Undergraduate and graduate courses for teachers of industrial arts and industrial education. Related studies in Economics, Education, English, Mathematics, Science and Art.

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1946 DATES

Inter-Session
June 10 to June 29
Main Summer Session
July 1 to August 10

Print-Shop Equipment

These maximum lists may be found helpful in checking inventories or preparing budgets.

If possible, each shop should have access to a projector, so that stills, silent movies, or sound movies, may be used also in the student's industrial arts and vocational education courses.

BELLOWS
- a) Hand, small size
- b) Electric, blower type

BLACKBOARD — permanent or portable

BOOKCASE — for reference books, catalogs, etc., sectional preferable

BRAYER — 6 or 8 in. for proofing

BRUSHES
- a) Bench
- b) Benzine, No. 1, oval black
- c) Floor
- d) Padding, 1½ in. wide

BULLETIN BOARD

CABINETS
- a) Galley, for double column, wood or steel, four tiers (to be used with typesetting machines)
- b) Galley, for 8¾ in. by 13 in. galleys, wood or steel, four tiers
- c) Ink and roller, to accommodate platen-press rollers, wood or steel
- d) Matrix, for use with typesetting machines only
- e) Roller, cabinet or rack for cylinder rollers
- f) Supply, for leads, slugs, spaces, strip material, with top for lead cutter and mitering machine
- g) Type, school type, each to accommodate two California cases, job cases, case slides, galley slide, and copyholder
- h) Type, complete with 24 full-size California job cases, with overhead lead-and-slug cases, wood
- i) Type, complete with 24 full-size California job cases, double work band, wood or steel
- k) Wood or metal, for filing class records, instruction sheets, etc.
- l) Storage for cuts

CANS
- a) Benzine, pint size
- b) Benzine, 5-gal. size
- c) Kerosene, safety, 1-gal. size
- d) Waste can, fireproof, for rags

CASES
- a) Blank, full-size, to accommodate ¼-size cases
- b) Border, ¼ size, for ornamental borders
- c) Lead and slug, regular size, to hold laborsaving fonts of leads and slugs
- d) Metal furniture, to hold laborsaving fonts
- e) Rule, ¼ size, for brass rule

CHAIRS — teacher's and tablet arm

CHASE RACKS
- a) For platen presses
- b) For cylinder presses

CHASES
- a) For each size of platen press
- b) For cylinder press

COMPOSING STICKS — 6 by 2 in., 8 by 2 in., 12 by 2 in., and 18 by 2 in., adjustable

CUTTER
- a) Lead and rule
- b) Paper, lever type, 20 in., with pedestal. Should handle 20 by 26-in. sheet
- c) Paper, lever type, 26 in. or 30 in.
- d) Paper, lever type, 30 in., with divided back gauge
- e) 30 in. to 36 in. power cutter

DESK
- a) Bindery, 80 by 36 in.
- b) Drying rack
- c) Imposing, 51 by 39
- d) Make-ready, 32 by 24 in.
- e) Paper cutters, 80 by 36 in.
- f) Proofreaders
- g) Teachers

DRYING RACKS
- a) Combination drying rack and stock table for platen presses, 30 trays
- b) Trays, interlocking, for cylinder press

FOLDING BONES — for hand folding

FOLDING MACHINE — 20 by 26-in. size, 4 fold, two parallel and two right-angle folds, power

FURNITURE — iron, 2 by 4 to 10 by 15 picas

GALLEYS — Steel, 8¾ by 13 in., 6¼ by 23½ in., double column, and 12 by 18 in.

GAUGE PINS — spring tongue

GLUE POT — electric, 1-qt. size

IMPOSING TABLES
- a) 12 by 18 in., with iron top, including reglets and furniture
- b) 24 by 36 in., with iron top, complete with galley slides, chase rack, reglets, and furniture
- c) 36 by 48 in., with iron top, complete with galley slides, chase rack, reglets, and furniture
- d) 39 by 63 in., with iron top, complete drawers, letter boards, reglets, and furniture

INK FOUNTAINS
- a) Short, for 8 by 12, 10 by 15, and 12 by 18 presses
- b) Long, for 10 by 15, and 12 by 18 presses

KNIVES
- a) Overlay, for make ready
- b) Ink, 6 in. and 8 in.
- c) Ink, 8 in., square end

LEADER BOXES

LEADERS
- a) 6, 8, and 10 pt., fine dot
- b) 8 and 10 pt., hyphen

LINE GAUGES
- a) Metal, brass, or steel
- b) Wood

MALLET

METAL FURNACE — for recasting and refining type metal, used only with typesetting machines

MITERING MACHINE

NUMBERING MACHINES
- a) For use on presses
- b) Hand machines

ORNAMENTS
- a) Assorted floral and decorative designs
- b) Border, 6 and 12 pt., decorative

PAPER-DRILLING MACHINE

PERFORATOR
- a) 24 in., foot treadle
- b) 28 in., foot treadle

PLANER
- a) Mallets, hickory or fiber
- b) Proof, maple, with felt bottom
- c) Type, maple, with leather top

PRESSES
- a) Cylinder, two revolution, four roller, 17 by 22, complete with variable-speed motor, cast rollers, etc.
- b) Platen, 8 by 12, with foot treadle, counter, flywheel guard, platen guard, brake, and set of cast rollers (motor and treadle combination if desired)
- c) Platen, 10 by 15, complete with variable-speed motor, counter, flywheel guard, brake, and set of cast rollers, etc.
- d) Platen, 12 by 18, complete with variable-speed motors, counter, flywheel guard, platen guard, brake, and set of cast rollers, etc.
- e) Proof, 14 by 18, with cabinet
- f) Proof, 20 by 24, with cabinet
- g) Proof, 23 by 24½ with cabinet
- h) Tableting

PUNCH
- a) Foot power, multiple with assorted punches
- b) Lever, two die, with assorted punches
- c) Power, multiple, with assorted punches (paper drill may be substituted)

QUOINS
- a) Sizes No. 1 and No. 2
- b) Keys, Sizes No. 1 and No. 2

RULE — plain and brass (fonts to fit quarter cases)
- a) 2 pt., laborsaving, hair line, side face
- b) 2 pt., laborsaving, 1 pt. side face
- c) 1 pt., laborsaving, 1 pt. face
- d) 2 pt., laborsaving, double face

SAW TRIMMERS — pedestal type, with point gauge, and raising and lowering table

SILK-SCREEN UNIT

SPACING MATERIAL
- a) Iron furniture, as selected
- b) Leads, laborsaving, 2 pt.
- c) Leads, 2-ft. strips, 2 pt.
- d) Slugs, laborsaving, 6 pt.
- e) Slugs, 2-ft. strips, 6 pt.
- f) Spaces and quads
- g) Thin spaces, brass and copper, assorted sizes, 6 to 8 pt., one size in each box

SPECIMEN DISPLAY BOARD

STAPLE BINDER — pedestal type, foot power

STEREOTYPING UNIT, 8 by 12 in.

STITCHER — wire, power, capacity ½ in. or ¾ in., flat- and saddle-back tables

TWEEZERS — 3½ in.

TYMPAN PAPER (with combination holder and cutter)
- a) 18 in.
- b) 38 in., upright, to be used with cylinder press only

TYPE
- a) Body, lightface — 8 and 10 pt.
- b) Job, lightface — 6, 8, 10, 12, 14, 18, 24, 30, 36, and 48 pt.
- c) Job, lightface italics — 8, 10, 12, 14, 18, 24, and 36 pt.
- d) Job, boldface — 6 and 8 pt.; 12 pt., No. 26; 12 pt., No. 27; 12 pt., No. 28; 18 pt., No. 30
- e) Job, light copperplate Gothic — 6 pt., Nos. 1, 2, 3, 4; 12 pt., Nos. 5, 6, 7, 8
- f) Job, condensed title Gothic — 12, 18, 24, 36, 48, 60, and 72 pt.
- g) Job, text type — 10, 12, 14, 18, and 24 pt.
- h) Job, typewriter type — 12 pt. with spaces
- i) Job, boldface italic — 8, 10, 12, 14, 18, 24, 30, and 36 pt.
- k) Job, heavy copperplate Gothic

(Continued on page 84A)

(Continued from page 78A)

which the subject is covered. The awards will be as follows: $200 each to the author of the best paper and to the publication in which it appears, and $150 each to the author and the publication for the second best paper.

Presentation of the first A. F. Davis Undergraduate Welding Awards for papers published between now and July 1, 1946, will be made at the next annual meeting in October, 1946.

For further information write to American Welding Society, 33 West 39th St., New York 18, N. Y.

For brief reference use IAVE—1221.

NEW ADVERTISING MANAGER APPOINTED

Paula S. Hoddeson has been appointed manager of Advertising and Sales Promotion of Walker-Turner Co., Plainfield, N. J.

For two years Mrs. Hoddeson has been sales promotion manager of the company, and prior to that was with the Public Relations Department of Halsey-Stuart Company, and Sales and Advertising Manager of Continental Sugars, Inc.

She attended both Rutgers and New York Universities, majoring in marketing and business administration.

PUBLICATIONS

(Continued from page 68A)

Vocational Training Problems When the War Ends
Vocational Division Leaflet No. 12. Price, 10 cents. Superintendent of Documents, Washington 25, D. C.

Directing Vocational Agriculture Day-School Students in Developing Their Farming Programs
Agricultural Series No. 56. Vocational Division Bulletin No. 225. Price, 15 cents. Superintendent of Documents, Washington 25, D. C.

Training Teamwork — Labor-Management
War Manpower Commission, Washington, D. C.
Five examples of apprentice-training service.

Safety Guide for the Farm and Home Front
General Mills, Inc., Chamber of Commerce Building, Minneapolis, Minn.

Careers in Labor Relations
By Florence Peterson. Occupational Monograph 32. Price, 60 cents.

Youth and the Skilled Trades
Bulletin VII. Connecticut State Department of Education, Hartford, Conn.

Opportunities in Printing Today

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AIRCRAFT MECHANICS SERIES

By Col. Rollen H. Drake

There will be six books in this new series of mechanics' manuals: *Aircraft Woodwork; Aircraft Welding; Aircraft Sheet Metal; Aircraft Engines; Aircraft Electrical and Hydraulic Systems and Instruments;* and *Aircraft and Engine Maintenance and Service.* The first two will be ready this spring. Each provides all the background information and specific training in tools and techniques needed to meet the licensing requirements in each branch of the aircraft mechanic's trade. Each $3.50 (probable)

SHAPER OPERATIONS

By Lewis E. King

This is the third in the author's series of machine shop manuals. Following the same plan as the previously published *Lathe Operations* and *Milling Machine Operations*, this book presents all the necessary technical information and careful directions for the skillful performance of each operation done on a shaper machine, together with many helpful "tricks of the trade." The author is Head of the Machine Shop Department in the Aero Mechanics High School in Detroit, and is himself an experienced toolmaker. $1.00 (probable)

AMERICA'S FABRICS

By Zelma Bendure and Gladys Pfeiffer

The most complete work ever published on fabrics, this is a *must* reference for students of distributive education and vocational home economics. It tells the whole story of every fabric being made today—nearly 1000 in all—with illustrations of each fabric and of every process used in its manufacture, and complete information about its characteristics, special qualities, and uses. $10.00 (probable)

(Continued from page 82A)

— 6 pt., Nos. 21, 22, 23, and 24; 12 pt., No. 25
l) Wood, condensed Gothic — 8, 12, 15, and 18 line
m) 10 pt. line leaders, 4 dots to the em
n) 10 pt. braces and dashes
o) 10 pt. fractions
p) 10 pt. references
q) Parentheses and brackets
r) 2 pt. laborsaving leads, 4 to 25 picas
s) 6 pt. laborsaving slugs, 4 to 25 picas
t) 2 pt. laborsaving brass rule
u) 2 pt. miters for rule
v) Laborsaving metal furniture
w) Thin spaces with quarter-size case

TYPESETTING MACHINES
a) Either linotype or intertype, 2 or 3 magazines, and molds
b) Matrices for same, 6, 8, 10, and 12 point, as selected

VISUAL AID CHARTS

Print-Shop Supplies

BENZINE OR GASOLINE — for cleaning type or presses

BINDERY TAPE — 2 in. wide, brown or black

GOLD BRONZE — pale

INK
a) Bond, black, for bond papers
b) Book, black, for school papers, etc.
c) Cover, colors as selected
d) Dryers and compounds, as selected
e) Half tone, black
f) Job, colors as selected
g) Metallic, gold and silver
h) Process, black, red, yellow, blue

KEROSINE — for cleaning rollers

PADDING CEMENT
a) Cold
b) Hot

PAPER
a) Bond, fine grade, 17 by 22 — 20, white
b) Bond, medium grade, 17 by 22 — 20, white
c) Bond, sulphite, 17 by 22 — 20, white
d) Bond, sulphite, 17 by 22 — 20, colors as selected
e) Book, enamel, 25 by 38 — 80, white
f) Book, machine finish, 25 by 38 — 80, white
g) Book, eggshell finish, 25 by 38 — 60, white
h) Cover, as selected, 20 by 26, medium
i) Card Bristol, fine grade, 22 by 28 — 4 ply, white
k) Index Bristol, medium grade, 25½ by 30½ — 110, white
l) Index Bristol, medium grade, 25½ by 30½ — 140, white
m) Mill Bristol, medium grade, 25½ by 30½ — 140, colors as selected
n) Pressboard, red
o) Strawboard, No. 40 or No. 50
p) Tagboard, manila, 24 by 36 — 140
q) Tympan, to fit presses
r) Wrapping paper, size as selected
s) Holder for same

PASTE
a) Bindery
b) Make ready

SILK-SCREEN SUPPLIES consisting of:
a) Silk-screen process paste paint, 1 each of the following colors: toluidine red, strontian yellow, ultramarine blue, medium green, rich brown, orange, purple, white, and black
b) Solvent profilm in 11- by 14-in. sheets
c) 8-in. synthetic squeegee
d) 11-in. synthetic squeegee
e) No-clog varnish
f) Film solvent
g) Stencil filler
h) Filler remover
i) Stencil knife
k) Fiber guides
l) Red sable brush — ½ in.
m) Putty knife
n) Frame tape

TWINE — cotton, for tying jobs

WIRE STITCHING
a) No. 28 round wire for stitcher
b) Wire staples, ¼ in.

Drafting Equipment and Supplies

These maximum lists may be found helpful in checking inventories or preparing budgets.

If possible, each shop should have access to a projector, so that stills, silent movies, or sound movies, may be used also in the student's industrial arts and vocational education courses.

ADJUSTABLE-CURVE RULER

BEAM COMPASS

BENCH BRUSHES

BLACKBOARD
a) Permanent or portable

b) Compass, 15 in., with locking device
c) Drawing set: T square, straightedge, triangle, and protractor

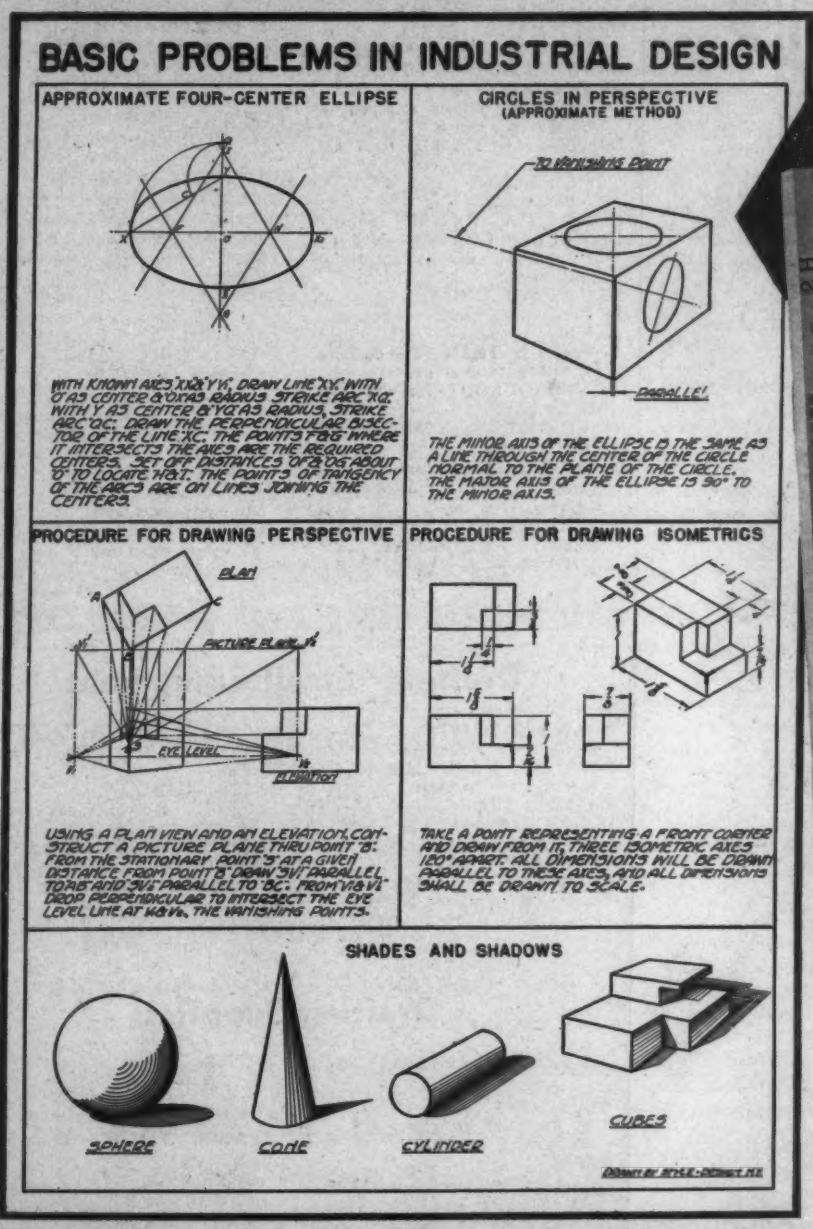
BLUEPRINT
a) Frame or machine
b) Washing trays or washer
c) Paper tube, airtight
d) Drying rack or dryer

BOOKCASE

CABINET
a) For filing drawings

(Continued on page 86A)

YOURS for the Asking!


BASIC PROBLEMS IN INDUSTRIAL DESIGN
APPROXIMATE FOUR-CENTER ELLIPSE
WITH KNOWN AXES X1X2 & Y1Y2 DRAW LINE XY. WITH O AS CENTER & OX1 AS RADIUS STRIKE ARC X1C. WITH Y AS CENTER & Y1C AS RADIUS, STRIKE ARC 1C. DRAW THE PERPENDICULAR BISECTOR OF THE LINE XC. THE POINTS F & G WHERE IT INTERSECTS THE AXES ARE THE REQUIRED CENTERS. SET OFF DISTANCES OF & EQUAL ABOUT O TO LOCATE H & I. THE POINTS OF TANGENCY OF THE ARCS ARE ON LINES JOINING THE CENTERS.
CIRCLES IN PERSPECTIVE (APPROXIMATE METHOD)
TO VANISHING POINT
PARALLEL
THE MINOR AXIS OF THE ELLIPSE IS THE SAME AS A LINE THROUGH THE CENTER OF THE CIRCLE NORMAL TO THE PLANE OF THE CIRCLE. THE MAJOR AXIS OF THE ELLIPSE IS 90° TO THE MINOR AXIS.
PROCEDURE FOR DRAWING PERSPECTIVE
PLAN
PICTURE PLANE
EYE LEVEL
ELEVATION
USING A PLAN VIEW AND AN ELEVATION, CONSTRUCT A PICTURE PLANE THRU POINT "3". FROM THE STATIONARY POINT "3" AT A GIVEN DISTANCE FROM POINT "3" DRAW 3V1 PARALLEL TO AB AND 3V2 PARALLEL TO BC. FROM V1 & V2 DROP PERPENDICULAR TO INTERSECT THE EYE LEVEL LINE AT V1 & V2, THE VANISHING POINTS.
PROCEDURE FOR DRAWING ISOMETRICS
TAKE A POINT REPRESENTING A FRONT CORNER AND DRAW FROM IT, THREE ISOMETRIC AXES 120° APART. ALL DIMENSIONS WILL BE DRAWN PARALLEL TO THESE AXES, AND ALL DIMENSIONS SHALL BE DRAWN TO SCALE.
SHADES AND SHADOWS
SPHERE
CONE
CYLINDER
CUBES
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NATION WIDE NETWORK OF POST DEALERS

(Continued from page 84A)

b) For storing drawing boards
c) For storing drawing instruments
d) For storing models

CALIPERS — 6 in. and 8 in., inside and outside
CHAIR — teacher's
DESK — teacher's
DIVIDERS — proportional
DRAFTING MACHINE — and accessories
DRAFTSMAN'S STEEL PROTRACTOR
DRAWING BOARDS — large
DRAWING-BOARD SUPPORTS — to be set on or attached to woodworker's bench
DRAWING TABLES AND STOOLS
a) For students
b) For teachers
INK-BOTTLE HOLDER
IRREGULAR CURVES — Nos. 17, 21, and 24, wood, rubber, or transparent
LETTERING ANGLES
LETTERING PENS — assortment of 12
LEVEL OR TRANSIT — builders' for architectural students
LEVELING ROD — for use with the transit
MACHINISTS' COMBINATION SET — 12 in.
MARKING PINS — for use with measuring tape, for architectural students
MICROMETER — 1 in., for mechanical-drafting students
OILSTONE — 3-in. case
PANTOGRAPH — 21 in.
PARALLEL RULES
PLANIMETERS
PLUMB BOB
SHEARS — for trimming blueprints and drawings
SPEED COUNTER — for mechanical-drafting students
STEEL SCALES — 12 in.
STOP WATCH — for mechanical-drafting students
TABLE
a) For cutting and trimming drawings and blueprints
b) For disassembling and reassembling machine parts and models
TAPELINE
a) 100 ft., steel, for architectural students
b) 50 ft., steel or metallic
TOOLBOX — containing 1 machinists' hammer, one 6-in. adjustable wrench, one 6-in. screw driver, one 6-in. combination pliers
TRIANGLES
a) 30-60 deg., 14 in. transparent
b) 45 deg., 10 in. transparent
TRIANGULAR SCALES — civil engineers' type, 12 in.
T SQUARE — adjustable or fixed head, for large drawing board or straightedge with parallel rule attachment for large drawing boards
WALL CHARTS — lettering, decimal equivalents, etc.
YARDSTICK

To be provided by, or for, each student

Drafting—Small Equipment

DRAWING BOARD — size to be specified by instructor
DRAWING INSTRUMENTS — as specified by instructor
ERASING SHIELD
IRREGULAR CURVE — Nos. 8 and 13, transparent
PENCIL COMPASS
PENHOLDER — for lettering pens
PENS — assorted, for lettering
PROTRACTOR — not over 5 in.
SCALE — 12 in. architects', triangular
SCALE GUARD
SLIDE RULE — 10 in., as specified by instructor
T SQUARE — to fit drawing board
TRIANGLES — 30-60 deg., 10 in. transparent, and 45 deg., 8 in. transparent

Drafting Supplies

BICHROMATE OF POTASH — crystals
BLUEPRINT
a) Paper, 36 in. wide
b) Writing fluid
PAPER
a) Cross section, 8½ by 11 in.
b) Detail, 24 by 36 in.
c) Drawing, 24 by 36 in.
d) Isometric, 7 by 10 in.
e) Tracing, 36 in.
POWDER — for tracing cloth
TRACING CLOTH — 36 in.
VAN DYKE
a) Fixing salts
b) Paper, 36 in.
c) Writing fluid

Drafting—Additional Supplies

To be provided by, or for, each student

ERASERS
a) Cleaning
b) Ink
c) Pencil
INK
a) Black, waterproof
b) Colored, if required
PENCILS — DRAWING, HB, 2H, 3H, 4H, and 6H
PENCIL POINTER PAD
THUMBTACKS OR SCOTCH TAPE

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The Steel Square *I. C. S. Staff*	254	1.50
The Slide Rule *Strohm*	N255	1.00
Building Stone—Foundations—Masonry *Lowndes*	245B	1.80
Plain and Fancy Brick Work *Lowndes*	248B	1.60
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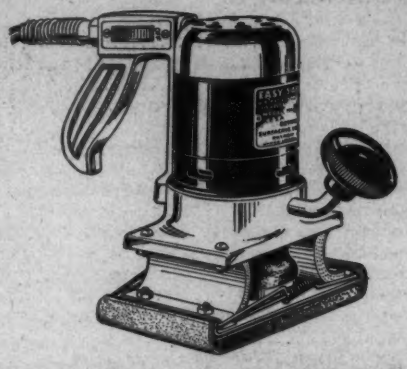

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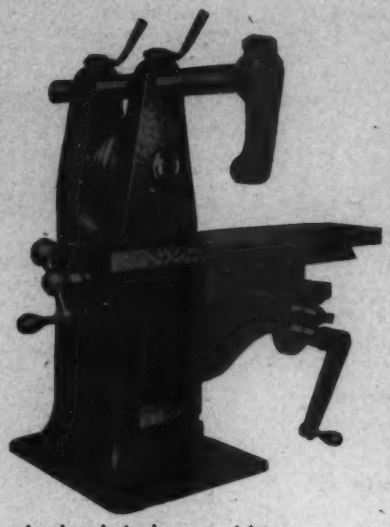

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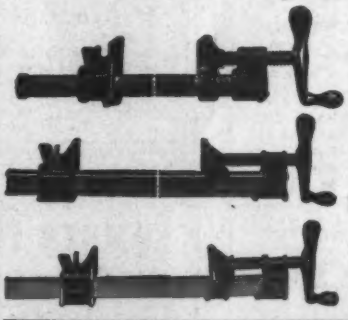

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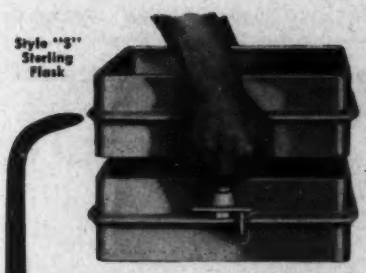

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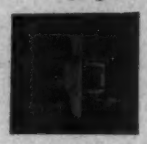

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BRUCE — MILWAUKEE

INDUSTRIAL ARTS AND VOCATIONAL EDUCATION
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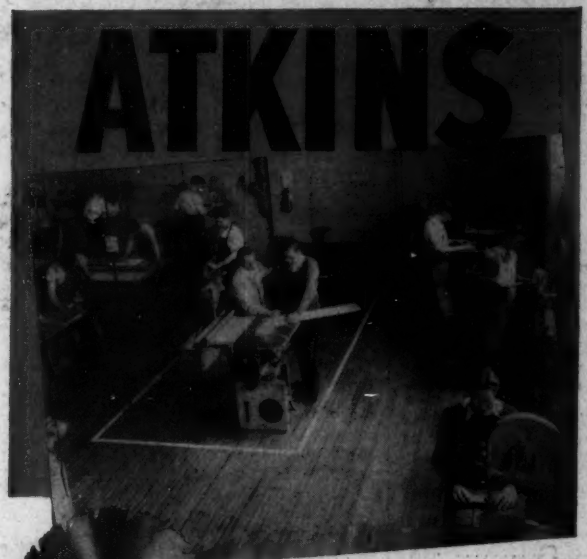

KNOWING HOW
comes from
LEARNING HOW
with the right tools

The "know-how" your pupils will have when they start at their chosen trades depends on the training they get today. As you know, keeping your school shop equipped with quality tools is a big aid to successful teaching. Atkins "Silver Steel" Saws are such tools. Correctly-designed, they inspire confidence in beginners' hands. Their "Silver Steel" blades have tough, keen teeth that hold an edge. And their ability to stand up under steady rough classroom use makes them easy on the school budget. Have the advantages of Atkins "Silver Steel" Saws by specifying them on your next requisition.

Free... WALL CHART ON SAW FITTING
Here's a real classroom aid. It shows the correct way of filing and setting saw teeth, with detailed illustrations. Overall size 19" x 25". Write for your free copy today.

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ATKINS *Agents and Dealers in All Principal Cities the World Over*

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HAND TOOLS FOR THE CRAFTSMAN

CHISELS AND GOUGES
For all types of woodworking . . . GREENLEE chisels and gouges of crucible steel provide tough, lasting, fine cutting edges. Various types of socket, tang butt and firmer chisels, gouges and turning tools.

AUGER BITS AND DRILLS
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EXPANSIVE BITS
For fast, uninterrupted cutting . . . newly-designed wide, open throat for positive chip clearance. Two styles: Set-fast Expansive Bit with quick adjusting-locking feature and Plain Expansive Bit.

SPIRAL SCREWDRIVERS
Built for years of hard service, the GREENLEE Spiral Screwdriver incorporates special, long-lasting, phosphor bronze drive nuts to withstand heaviest wear. Adjustments are quick, simple, positive. Available in small, medium and large sizes—with or without spring return.

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Completely enclosed working parts keep out dirt and grit. Hardwood handle serves as readily-accessible magazine for 8 drill points supplied. Constructed with special phosphor bronze drive nut for long wear.

The GREENLEE Line also includes razor-blade draw knives, bit extensions and other high-quality tools for the woodworking craftsman.

For complete information on GREENLEE tools, write Greenlee Tool Co., Division of Greenlee Bros. & Co., 2023 Twelfth Street, Rockford, Illinois.

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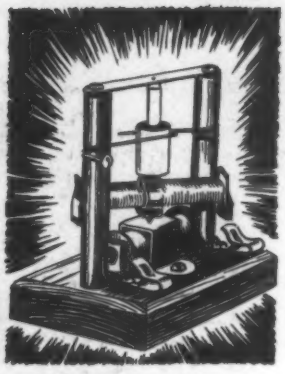
A partial list of

BRUCE SHOP BOOKS

Texts and Projects



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An excellently planned course.
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Five separate paper bound volumes: 1. The Engine; 2. Cooling, Lubrication, and Fuel Systems; 3. Automotive Electricity; 4. The Power Flow; 5. Chassis Units. Each, *$1.00*

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How to transform discarded tin cans into objects of beauty and usefulness.
Cloth, *$1.25;* Paper, *75 cents*

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Very simple, modernistic patterns, clearly presented. *$2.00*

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Detailed, step-by-step descriptions enabling the student to spin thirty-two articles. *$1.75*

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Practical, especially slanted mathematics for girls. *$1.56*

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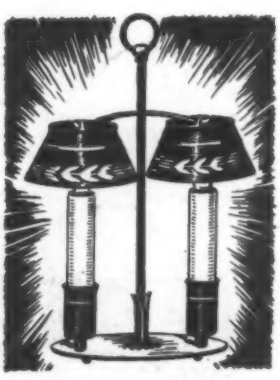
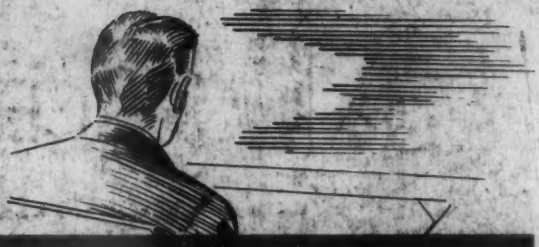


Examination copies may be obtained upon request for 30 days' study

THE BRUCE PUBLISHING COMPANY
703 MONTGOMERY BUILDING MILWAUKEE 1, WISCONSIN

You've been talking BEHIND OUR BACKS *again*



We heard rumors that some pretty nice things were being said about the Regal amongst vocational instructors and supervisors. Our ears got to burning so badly we couldn't stand it any longer, so we asked some of you to let us in on the gossip. A letter from a Director of Vocational Education in Indiana stated as follows:

"We have had one of your 15" Regal Lathes for the past five years. Recently we purchased two more of these machines.

"The things I like particularly well about them are:

The rounded tops on the vee and flat ways which stand up much better than the conventional type of construction.

The simple, yet positive, clutch mechanism in the apron which is superior to any other machine we have in the shop.

The drive gear in the headstock which allows us to take heavier cuts than on corresponding flat drive machines."

Actually the list of things he liked was much longer, but you get the idea. He finished his letter with, *"I could go on and on, so you see I am sold on your machine. In fact, although I have one lathe in my basement workshop, I intend soon buying a small Regal for myself."* (Writer's name supplied on request.)

Many are the reasons why LeBlond Lathes are preferred in school shops. We are receiving more and more of them from the men best qualified to judge training lathes—the directors and instructors who see these lathes in daily operation.

Can your shop afford to be equipped with anything less than LeBlond Super Regal Trainers?

WRITE FOR FULL DETAILS AND SPECIFICATIONS

SINCE 1887 THE WORLD HAS BEEN TURNING TO LEBLOND FOR TURNING EQUIPMENT

THE R. K. Le BLOND MACHINE TOOL COMPANY, CINCINNATI 8, OHIO, U. S. A.

NEW YORK 6, Singer Bldg., 149 Broadway, WOrth 2-0722; CHICAGO 6, 20 North Wacker Drive, STA 5561

LARGEST MANUFACTURER OF A COMPLETE LINE OF LATHES